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New Series, Vol. VIII
Old Series, Vol. XXVII | Chicago | MAY, 1912 | New York | No. 5

Special Articles in This Issue

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Intermittent Contact Signal for Electric Railways

Announcement of Cash Prize Contest

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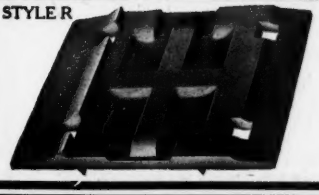

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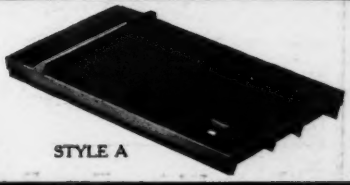

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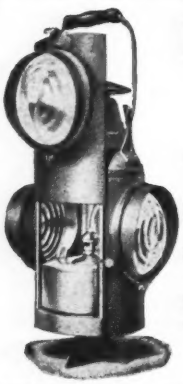

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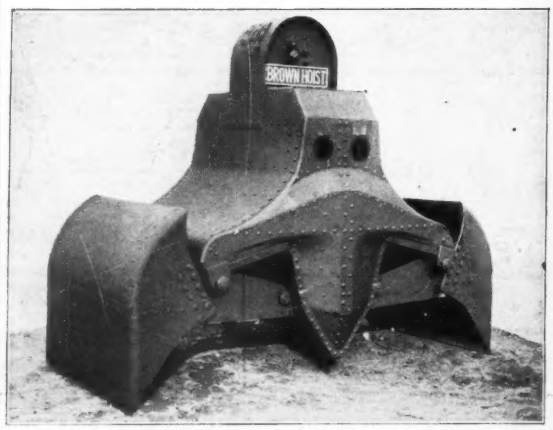

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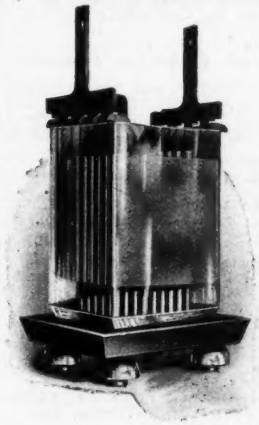

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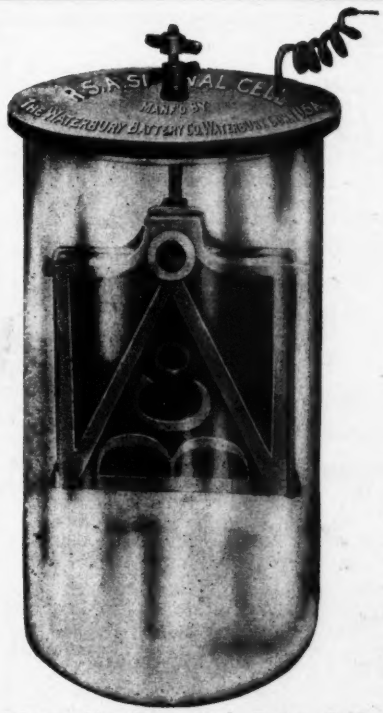

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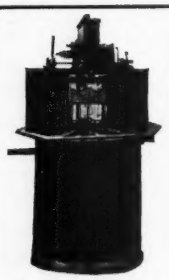

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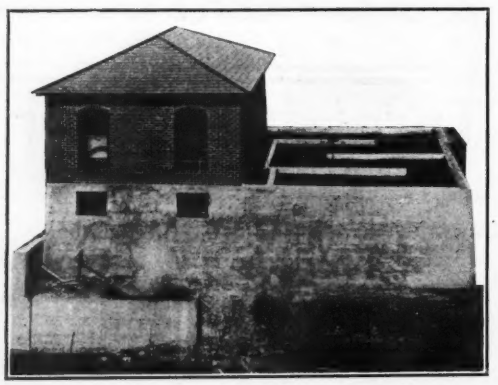

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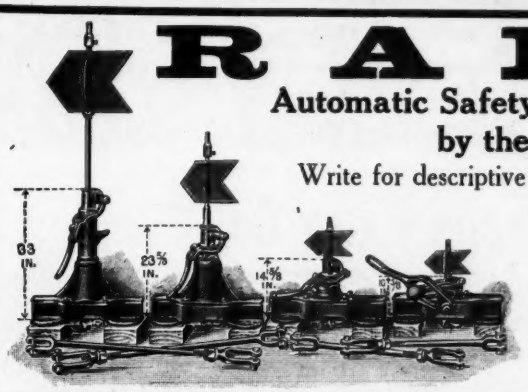

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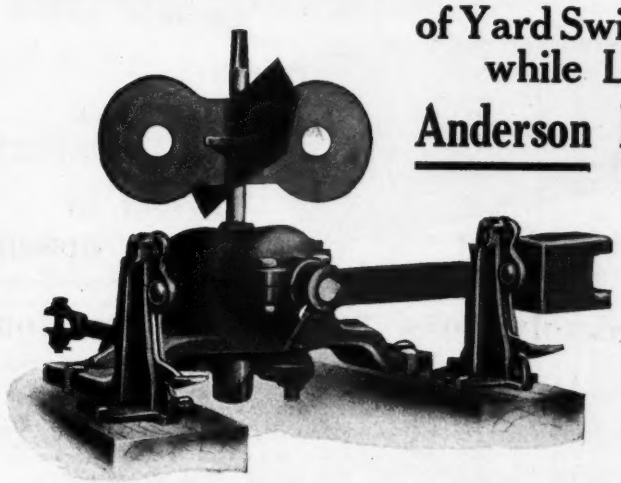

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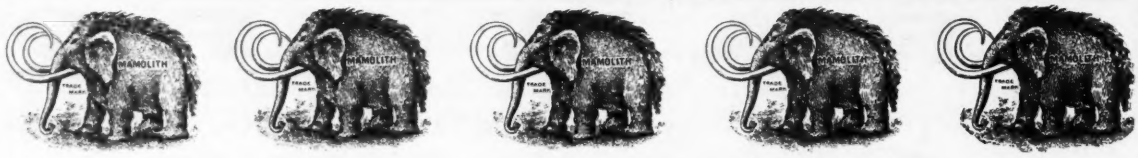

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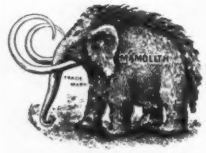

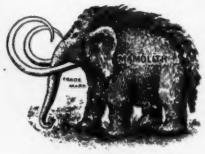

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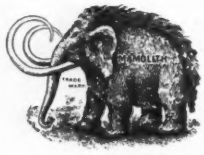

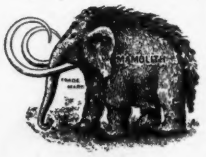

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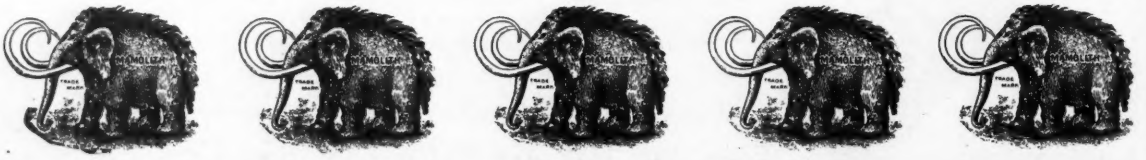

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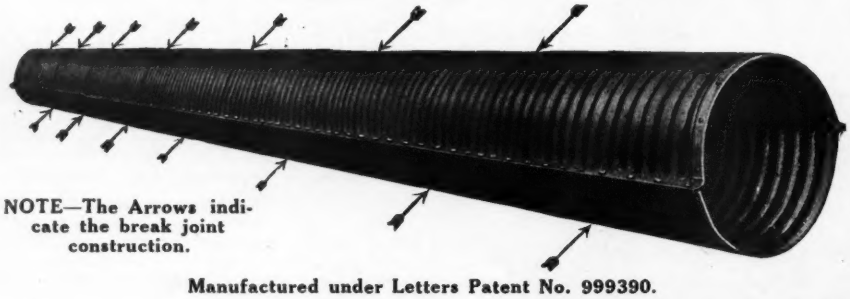

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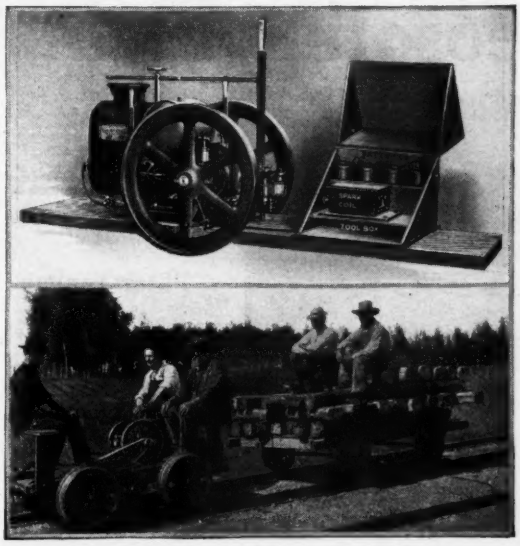

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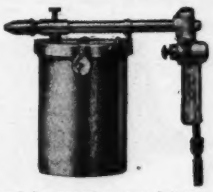

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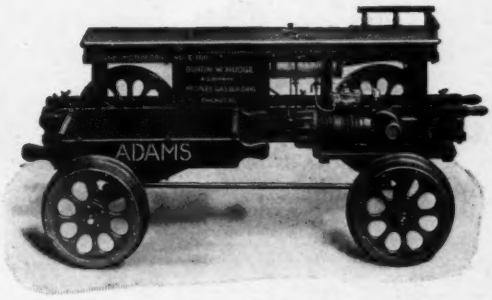

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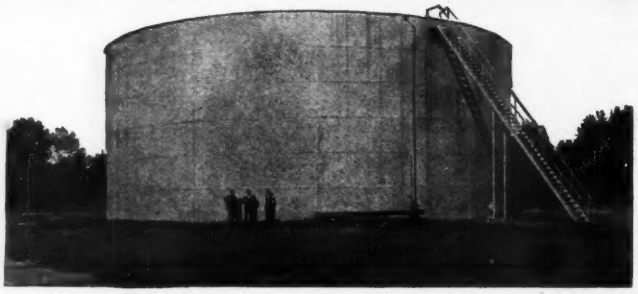

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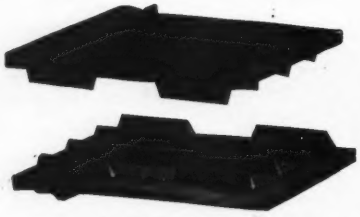

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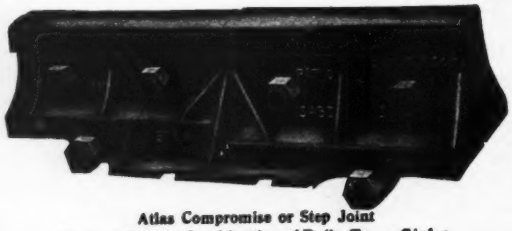

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Labor Situation.

ALL THOSE who have been connected with the construction and maintenance departments of the railways are familiar with the constantly increasing scarcity of labor. The "old timers" will remember when there were two men for every shovel, and they were intellignt and capable laborers, too. In those days it was easy for a foreman to get the maximum work out of each laborer, for he knew that there were many others to take his place. At present the successful overseer of labor is he who can organize and obtain work from his men and at the same time retain their good will, and who can hold his men in spite of the demand for them in other places. And it is possible for a foreman to be popular with his men, and still maintain the strictest discipline.

The demand for labor has led to an immense influx of foreigners of different classes. Many of these are intelligent and willing, and make excellent laborers if they are started right and subjected to good discipline.

The heavy demand for laborers led to the establishment of labor agencies, which were useful and valuable in the beginning. By paying a small fee the laborer could easily find work which it might take him weeks to find unaided. The labor agencies, soon after their establishment, began practicing rather questionable methods. The railway companies, through favoritism or otherwise, would designate that all the laborers should be shipped out by certain agencies. Many times has the "hobo" enquired in vain for a job from the foreman of a gang, and later been sent to the same job after the agency has received its fee.

The object of the labor agency was, at first, to supplement the efforts of the foreman. Under present methods it is a hindrance, and especially is it so when an exhorbitant fee is charged. When this is done, in any case, the experienced laborers will refuse to pay the fee, and will look elsewhere for a position. Only the green men, new arrivals in this country, or the worthless men will pay an exhorbitant fee for a job which pays the small wages which are usual on railway construction and maintenance.

If the object of a labor agency is to obtain laborers, then the charge should be small, and the foreman should be given the option of hiring good men wherever he finds them. When it is understood that all laborers must come through a certain agency, then it looks as if the obtaining of laborers is a secondary object. For then will the laborer be forced to pay an excessive amount for his job, and unless the wages are appreciably larger, only the poorest men will be obtained. The primary object then must be personal gain, ultimately at the expense of the company.

That system is a bad one in which the foreman is not allowed to hire those whom be knows to be good men. If he has been long in railway work and is a live man, he will know many laborers of exceptional ability whom he can obtain; men whose qualifications and limitations he knows. The work of organizing a gang is much less where there is a number of laborers on whom the foreman is sure he can depend.

The man who is wheedled into paying an exhorbitant fee for a job is always a hard man to get work out of. The advantages and ease of the work are misrepresented to the best of the agent's ability. And when the laborer gets on the job he is inclined to be dissatisfied and unwilling, thinking that it is

impossible to discharge him, since he has paid a good price for the job.

The scarcity of labor makes the foreman's work hard enough, without the added disadvantages resulting from his entire lack of control over the selection of his men, the discontent caused by the misrepresentation of the labor agent, high fees and shipments through exclusive agencies. Many of these abuses would not be possible if obtaining laborers were the sole object in hiring through a labor agency.

Co-operation.

A GOOD DEAL of trouble and needless expense has been caused in the past by lack of co-operation among different railway departments. A great deal of this can be attributed to jealousy, and to ambition, which tramples on others in order to attain personal advancement. On a construction job there are representatives of the location, construction, and maintenance departments (sub-divisions of the engineering department) and also the operating department.

The trainmen are inclined to consider themselves supreme, and to imagine that they have enough ability to offset a good many years of experience of the track men. These men will confidently advise and give orders about the work over which they have absolutely no jurisdiction. The trainmen are naturally a very independent lot on account of the strength of their organization and this independence works to the disadvantage of the construction men. If these men can be brought to realize, as a whole, that assistance is not needed except to handle their trains expeditiously, matters would be greatly improved. And it is usually a fact that those trainmen who have been on construction work for a good while, are the easiest to get along with, and the least likely to attempt to do the foreman's work for him. It is the trainman who is assigned to construction for the first time who is the most generous with suggestions and criticisms.

It is with some timidity that we touch upon the relations of the civil engineer and the track foreman. In former years there was bitter jealousy and enmity between these men, but this feeling, we are glad to say, has practically disappeared except in a few exceptional cases. A good many years ago, when the demand for civil engineers was much greater than the supply these men were inclined, as a class it seems, to imagine that they had learned everything in school that it was possible to know, and that their technical knowledge was so great that practical experience was insignificant in comparison. At the present time, the class of men who are being graduated as civil engineers are entirely different, and as a class are reasonable, easy to work with, and inclined to give the foreman credit for his practical knowledge, and if competent, to let him manage the details as he thinks best. Of course there are exceptions to this rule, but at the present time there is no general ground for antipathy between these two classes and the old feeling is rapidly passing away.

Between construction and maintenance departments there is many times a feeling of animosity. The maintenance people charge the construction forces with hasty and poor work, entailing abnormally heavy maintenance. On the other hand, the construction forces are liable to think that the maintenance people are asking too much in order to make the maintenance charges light, and the construction charges heavy. Much of the trouble resulting can be eliminated by requiring a first class grade of work in every case, and not paying so much attention to the amount of work. A great deal of poor work has been done by men out to make a "record." We recall one case where a construction foreman made a great showing surfacing dirt track. As long as he was on the job the weather remained fair. A heavy rain occurred a week or so after he left, and the track went to pieces in a night. Subsequent investigation by his successor showed that he had done no center tamping at all. The ends of ties had been tamped, and the centers merely filled in and dressed up. The result was that the track was in worse shape than if it had not been surfaced at all, because the center of the grade was full of water. And the worst feature of the incident was that the new foreman was blamed for the condition of the track.

Co-operation between the different railway departments and sub departments makes each man's work easier, and results greatly to the benefit of the railway company. The centralization of the authority on each job, as far as possible, in men who are known to possess ability, is bound to further co-operation. This principle is being recognized more and more. On a large job, with a number of track gangs, central authority should be invested in one competent man who is interested in furthering the *whole work*. It will then be impossible for one man to make a showing at the expense of another, and the general foreman can be held responsible for all parts of the work.

Promises.

NEARLY EVERY responsible person is accustomed to consider his promise as good as a note, and when he gives his word will do everything in his power to live up to it. Many others (too many at any rate) are given to making promises and then forgetting them, intentionally or otherwise. These kind of people are such a small percentage, and we are so given to relying on promises, written or oral, that we get used to relying on every one's promise, sometimes to our regret. It is our firm conviction that every *man* keeps his promise, or if impossible, he asks to be released, giving excellent and sufficient reasons.

Relying on your word, some other man gives his promise, and maybe it is passed on through a dozen hands until in the end you cannot tell how many will be inconvenienced should you fail to make good. The moral of this being: *Make promises only after careful consideration and then keep them.*

Competition.

COMPETITION among companies in many fields has been practically stifled by immense combinations, but in the railway supply field the competition for business, while keen during former years when railways could afford to buy plenty of equipment, has in the last few years been extremely bitter because of reduced appropriations by the railways.

The keen competition has lead manufacturers to cut their profits to the lowest limit in order to obtain full share of the meager orders. Invention and improve.ent have been

greatly stimulated also. The older companies especially are redoubling their efforts to improve their products so that they will be preferred above the others and to manufacture them at lower cost.

The result is that the products of responsible firms can today be purchased at much lower prices than formerly, and in most cases, the quality of the product has been greatly improved. No longer need a man guess at the qualities of the devices which he orders. The names of the responsible firms in the railway supply business and the merits of their products are becoming known through continuous advertising. And a man cannot go far wrong when he ties his faith to a company which sells its products through advertising and not through favoritism or by rebating.

RAILROADING AROUND THE WORLD.

By W. L. Saunders, Pres., Ingersoll-Rand Co.

A traveler who encircles the globe learns to appreciate the value of American railways. He also learns to prefer railway traveling, when long distances are concerned, to traveling in ships. One who visits Japan from the United States goes nearly half way around the globe, and if he is in a hurry to get home, appreciates comfort and likes to visit new scenes, he is better off coming home by way of Siberia, Germany, France and the Atlantic Ocean rather than to subject himself to the monotony of the broad Pacific. He may also save a few days, if he makes his connections.

The broad Pacific is interesting only in the contemplation of its expanse. No one can conceive of greater solitude than to be afloat on the Pacific Ocean. Its wave motion is usually moderate, with a broad expanse between the undulating crests. It is smooth on the surface and there are no signs of life, save an occasional flying fish, a rare encounter with porpoises and a whale now and then, whose antics are as welcome to the voyager as sunshine is to the Londoner in a November fog.

Recent railway construction and much improvement in equipment and operation add greatly to the comfort of the Trans-Siberian journey. Until recently one either crossed the Japan Sea, about a three days' journey, or took a more distant route to Port Arthur, and then made his way toward the Russian railways. But now it is simply necessary to travel by the Government railway of Japan to the extreme south of the Islands, Shimenoseki, then across the narrowest body of water in that section which separates the Continent from Japan. This is a one night trip only, in comfortable boats, landing one at Fusan, Korea. A word or two might be said of the railways in Japan. All the principal lines are owned by the Government, and this is always bad. It makes for inefficiency, bad management and lack of the best accommodations. Furthermore the railways in Japan are narrow gage roads, which seem to serve the purpose very well in a small country where the people are personally small in stature, and where furniture and accoutrements, such as we enjoy, are rare. These narrow gage railways are very well equipped for narrow gage railways. The trains go at considerable speeds and except in over night service one is reasonably comfortable.

The road from Fusan northward through the center of Korea is of broad gage with modified Pullman accommodations, under Japanese management, and an improvement on anything experienced in Japan. This road runs continuously through Seoul to Mukden, thence northward on the eastern Chinese Railway to the junction of the Trans-Siberian road at Harbin.

These railroads are patrolled by Japanese soldiers and operated by Japanese workmen. The soldiers do their duty in a manner above criticism, but it evident that the Japanese are not naturally mechanical and that operating railroads is a service of great difficulty to them. They have in Japan, for instance, copied American and European types of locomotives and so far as the reproduction is concerned it is perfect, but if anything goes wrong, if a connecting rod should work loose or a hot box trouble occur, the Japanese workman shows little initiative and skill. He is very apt to try the very same experiment he tried when a previous trouble arose, though the causes may be quite different. I have seen six or eight men puzzle for an hour or more over a simple case of hot box, trying all sorts of remedies and showing a lack of clear knowledge of the theory of the trouble. A Japanese mechanic laboriously learns to do a certain thing and when he masters it he can do that thing well, but if you shift him or introduce a new element in his work he is ill at ease. A simple illustration of this occurred on a Japanese railway where the clasp holding a lady's traveling bag was pulled out. Both the conductor and brakeman puzzled for at least twenty minutes in an effort to repair the damage, when the lady herself (a girl of twenty years of age) impatiently took the bag from their hands and fixed it.

The Trans-Siberian Railway runs from Vladivostok to Moscow, a journey of from eight to nine days. The equipment, especially on the International train which runs once a week, is first class, with comfortable cars and good food. In the extreme east coal is burned on the locomotives, but as one reaches the interior of Siberia, where wood is plentiful, the engines are all wood-burning. The gage of this railroad is five feet, which adds to the size and comfort of the cars. The staterooms are large,—some with two beds and others with four. These cars are all of the Russian type, the same as used on the Nord Express, which runs from St. Petersburg to Paris, and on the Orient Express from Paris to Constantinople. The speed averages a little more than twenty-five miles an hour, generally about thirty, and at times even faster. Stops at stations are not as infrequent as one would suppose, but occur in periods of two or three hours. The country itself is not a barren waste; there is no desert land in view, but it resembles Canada or a portion of the western United States. There are times that one would suppose the train was going through the Coeur d'Alenes in Idaho, or northward through the Cobalt District in Canada. The country is rolling, mountainous only around Lake Baikal and at the Urals there is much evidence of forests, burned for the purpose of clearing.

There is really less inconvenience, less friction and more real comfort of travel in a trip from Vladivostok to Moscow than from Paris to London. This statement is made deliberately by one who has had experience. Railway traveling becomes tiresome and excites one's nervous system in proportion as the trains wabble around curves, as the cars are crowded and as changes are required, while making a journey. This little trip from Paris to London involves all the difficulties of travel. The trains in France and in England are always crowded. There is a rush to look after one's baggage, the cars are light, the tracks laid in curves, the speed high, and one is apt to reach the end only to find it necessary to scramble on to a little bateau with few, if any, comforts, and a passage by water which is either rough or extremely dull. On landing the same experience is repeated.

One learns to appreciate the Pullman car, which through its heavy weight, wide berth and open construction is supreme over anything abroad. While the road beds of Europe are fairly good, little irregularities are more plainly felt through the light equipment used there, hence car sickness is more frequent. The dining car service is satisfactory only in that the food is good. There is little variety about it as it is table d'hote and is served in a perfunctory manner, with a rush and clatter of dishes exceeding anything experienced in an American diner.

Effect of Wood Structure on Preservative Treatment.*

About six and one-half years ago, when I first became interested in the preservation of timber, I made a trip of inspection of a number of wood preserving plants throughout the United States. I was usually received with the utmost courtesy and was generally ushered into the plant and, after considerable manipulation, was shown the roof, the treating cylinder, a few cars filled with treated lumber and was given the "glad hand" and told to call again. Many of the plants had a high board fence all around them, and some of them four or five strands of barbed wire on top of the fence. Just about two years ago I had occasion to visit a number of these same plants and I found the attitude had changed quite materially. The barbed wire was taken off, and the fences, because they hadn't been treated with creosote, had rotted, so that any one could see what was going on.

Only six years ago you could visit a plant and you would find the operator conducting his investigations in the utmost secrecy; in other words, he thought he had "the world by the tail." If you went to another plant you would find that the

Fig. 1. General Shape of Wood Fibres.

operator there was doing nothing different from what the other fellow was doing, although he, too, had a hold of that tail. The information I got didn't fit at all. I couldn't make any kind of a picture. I didn't know what was the matter until I visted a plant on the Gulf and was talking of my troubles to the general manager. He said: "Why, Weiss, there is something about the smell of creosote that makes a man a liar." That cleared up the whole field. From that time on I have been able to look at the wood preservation industry in a little different light from what I did.

I am glad to state, however, that the attitude is fast changing. I see no reason, and those of you who are firmly established in the industry must see no reason, for attempting to keep matters in secrecy. There is no secret connected with the proper treatment of timber when you get down to a logical, common-sense, business basis. There is plenty of room for all, and I think that the field has wonderful possibilities for expansion.

I want to point out briefly a few ways in which the operation of treating plants might get into new lines. All we are interested in at the present time is in the preservation of timber against decay, against rot. We are just trying to upset one of the natural conditions of nature. Nature made woods of various kinds; some durable, some not durable. What we are trying to do is to take these woods which are not durable and make them durable by artificial means. But I believe we have much greater possibilities than that.

There are thousands of feet of lumber every year being utilized in the construction of buildings that need fireproofing. Now, how many have gone into this question of fireproofing? Very few, I think. It is a good field that offers promising returns.

Then there is another line very closely connected with the operation of treating plants which might be termed the "conditioning of wood;" that is, giving it certain qualities that people want, but which nature did not naturally give it. We can take a piece of maple and in a treating cylinder, condition it and make it look like "silver wood;" ordinary yellow birch can be to imitate black walnut. Wood like this ought to be well adapted for furniture, parquet flours and conditions of a similar kind, because it has the same color throughout, and if worn will always remain the same color as long as any of the

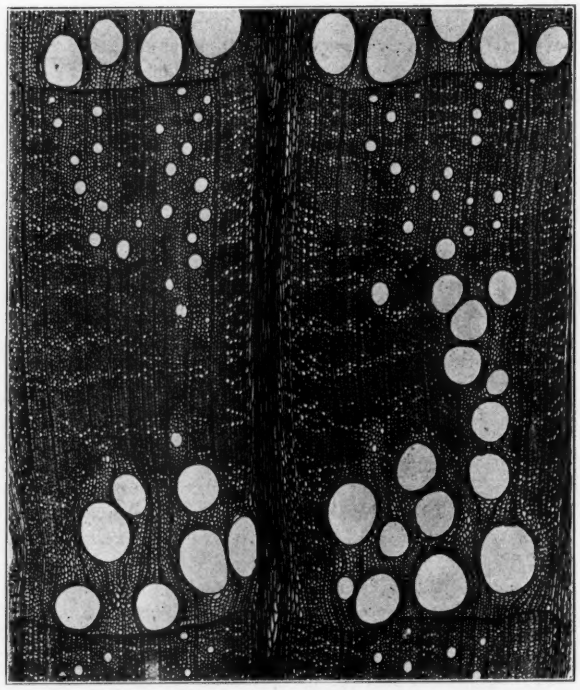


Fig. 2. Cross Section of Red Oak—a Ring Porous Wood.

wood is left. All this is within the realm of possibility, but at present this operation is purely in an experimental state.

There is still another line. Wouldn't it be a valuable thing if we could take, say, a loblolly pine tie and make it just as hard as a white oak tie? We can already make it just as durable as a white oak tie. Here is a piece of red oak that has been "conditioned" in a treating cylinder and its strength more than doubled. In other words, by a manipulation in the cylinder this piece of oak was made twice as hard as it originally was. This, also, is in the experimental stage. Can it be developed commercially? I do not know, but if these things can be done it will enable you gentlemen, who are interested in the operation of commercial plants, to reach out beyond your present field of merely protecting timber from decay.

We have conditioned a number of different kinds of wood in our treating cylinders. Ordinary maple can be made to look like silver wood. Ordinary yellow birch can be made to resem-

*An address given before the eighth annual convention and abstracted from the Proceedings of the Wood Preservers' Association. By Howard F. Weiss, assistant director of the Forest Products Laboratory, Madison, Wis.

ble black walnut so closely that 90 people out of a hundred couldn't tell it from black walnut. White oak can be given a beautiful brown color by manipulation in the treating cylinder—simply a temperature change.

In order to properly treat wood, it is necessary to know wood. We have spent much time in discussing specifications for creosote and zinc chloride, the scientific operation of plants, etc., and I came to the conclusion that enough time wasn't being given to a discussion of characteristics of the woods which we are handling every day. Many are inclined to believe that wood is a homogeneous substance like steel or glass. It is one of the most variable structural materials with which we have to deal. It is practically impossible to get two pieces of wood, even from the same tree or from the same location in the tree, that will be exactly alike. I heard a gentleman say that in his experience he found nothing more variable than wood except woman.

Wood appears differently, depending on how it is cut. In practice three planes are generally recognized. A section cut across the grain is known as the "cross-section." A longitudinal section cut in the plane of the radius or pith rays is called a "radial section." It is the one which gives the quarter-

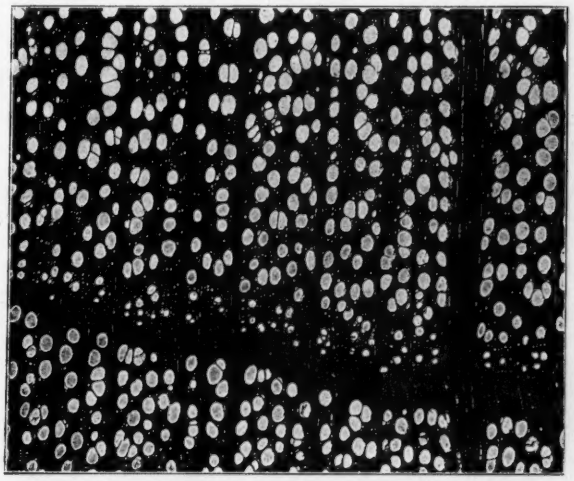


Fig. 3. Cross Section of Beech—a Diffuse Porous Wood.

ing effect in oak or the edge grain in flooring. The other section, which is also cut longitudinally, but at right angles to the radius or pith rays, is known as the "tangential section." I wish you would keep these three planes clearly in mind, as it will help to understand some of the illustrations which follow.

I want you to consider a piece of wood as being made up of an immense number of "cells" or fibers. Figure 1 will give you some idea of what a fiber looks like. Of course, in nature the fiber is straight, and not bent as in the illustration. You see from the general shape of the fiber the proportion of its diameter to its length. Wood can be considered as being made up of a mass of these fibers all cemented and dovetailed together. While they vary considerably in shape, number and size, for our present purpose let us consider all being of this general character.

There are a great many things about wood structure which affect its commercial treatment. In my opinion the principal ones are: 1. The vessels or "pores." 2. Resin ducts and resin cells. 3. The thickness and character of the cells. 4. The moisture content of the wood. 5. Sap-wood and heart-wood. 6. Bark.

I am going to elaborate on each of these and show what effect each has upon the treatment of timber.

Vessels or "Pores."

From a structural standpoint we can divide all of our American timbers into three big groups, depending upon the distribution of the vessels. A vessel can be considered as a tube running up the tree, that is, in the direction of the fibers. Based on the distribution of the vessels, then, our woods are divided into the "ring porous," "diffuse porous" and "non-porous" groups.

Figure 2 represents a piece of red oak under magnification and is known as a ring porous wood, because the pores or vessels occur in rings in the spring wood. These big pores are formed in the spring so that water and sap can be transmitted quickly to the leaves. Then as the season progresses the heavier cells are formed in what is called the summer wood, and they give the tree its strength. In other words, from spring wood to spring wood represents one year's growth.

Ring porous woods are also represented by oak, hickory, ash and a few others, and the pores in all of them form concentric rings.

How do woods like this treat? If put into a treating cylinder the preservative goes directly into these pores, and that is practically all the treatment they ordinarily get. I took some pieces of red oak that were thoroughly air seasoned and some that were absolutely green. I put them into a treating cylinder and gave them both the same full cell treatment. Both of them were

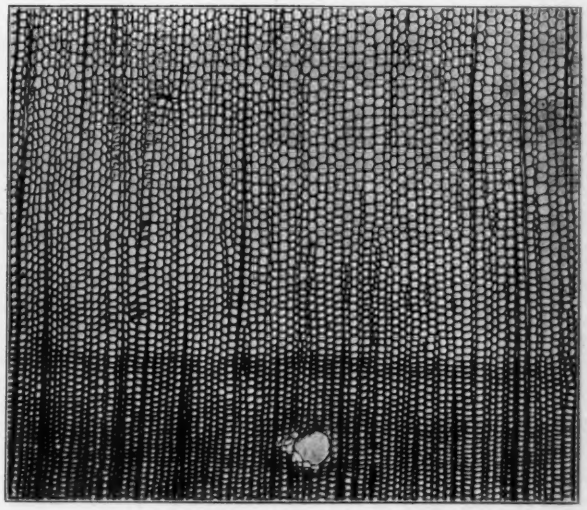


Fig. 4. Cross Section of Short Leaf Pine—a Non-Porous Wood.

penetrated to the very center, but the penetration in both cases was confined to the pores. None of it occurred in these little cells in the summer wood, which are very heavy walled and very closely packed together. That is the kind of treatment you ordinarily get in a red oak tie. You practically get it all in the rings of the spring wood.

Figure 3 is a microphotograph of a piece of beech in cross section. Notice the difference in its structure as compared with the red oak. Woods like this are called "diffuse porous" woods, because the vessels are scattered entirely throughout the year's growth. Maple, birch, cherry and gum are other examples of diffuse porous woods. If a piece of wood like this is treated in a cylinder the characteristic treatment is for the fibers to become filled with the oil uniformly or else in irregular streaks. Those who have had experience in treating maple, for example, are well aware of the manner in which the oil penetrates. It is radically different from the treatment of woods like the red oak.

Figure 4 illustrates a "non-porous" wood. By a non-porous wood I mean one which has no vessels. This condition is char-

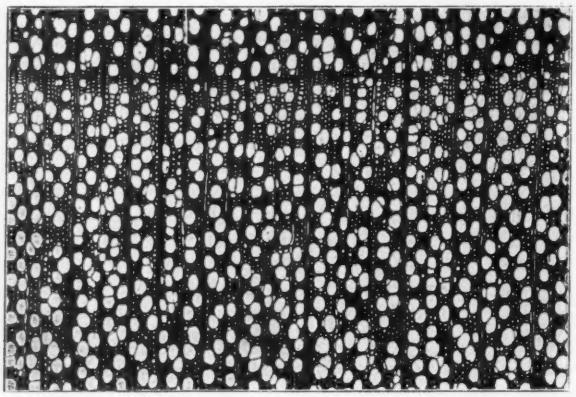


Fig. 5. Cross Section of Red Gum, a Diffuse Porous Wood.

acteristic of all conifers, such as the pines, hemlocks, spruces, firs, etc. Notice the uniform structure of the wood as compared with the red oak. It is so uniform in structure that it is a comparatively simple thing to season a conifer, compared with most hardwoods. You will notice even in this kind of wood the tendency to form thicker cells in summer. These are the cells which give the tree its strength.

Figure 5 is a microphotograph of red gum in cross section. Figure 6 is the same wood in the radial section.

Figure 7 illustrates the tangential view of red gum. Figures 5, 6 and 7 show how the three planes of wood look under the microscope. You can take a piece of red oak four feet or more in length and blow through it. You can't do that with white oak. White oak is used for liquid containers, but not red oak. Why? The reason is that in white oak there is a growth which takes place filling up the pores, partitioning them off, so to speak.

Notice, for example, how the pores in Figure 8 are filled with cross walls. Among botanists this growth is known as "tyloses." It is characteristic of white oak and that is one of the reasons why white oak is exceedingly difficult to impregnate with a preservative fluid. Tyloses occur in a number of different woods. They are characteristic in hickory. We find them sometimes in the resin cells in conifers, and that is probably why some conifers are hard to treat. The chief difference, therefore, from a wood preserving standpoint, between white oak and red oak is in this tylose formation. Tyloses probably furnish the reason why white oak is naturally durable and red oak is not durable.

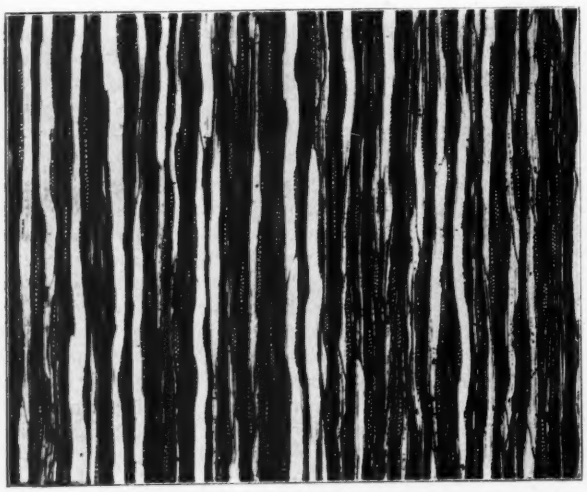


Fig. 7. Tangential Section of Red Gum.

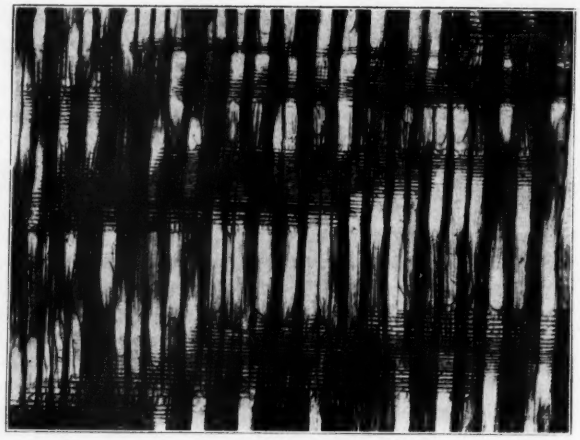


Fig. 6. Radial Section of Red Gum.

Figure 9 represents a tangential section of a piece of white oak. It shows how these long tubes are broken up by this tylose formation.

Resin Ducts and Cells.

We now come to the second factor affecting the treatment of wood, that is, resin ducts and cells. Resin ducts occur only in the non-porous woods. From a wood preservation standpoint they are comparable to the vessels in the hard woods.

Figure 10 illustrates a piece of longleaf pine in cross section. Notice how much more open the cells are in the spring wood as compared with the heavier cells in the summer wood. This difference in the cells of the spring and summer wood is what gives a longleaf pine paving block a banded appearance. The large openings are called "resin ducts." They are the vessels in which the resin is formed and stored.

The distribution of resin ducts varies considerably among the various conifers. For example, they are few in the firs and spruces; and firs and spruces, as a rule, are woods that are generally hard to treat, but they are much more abundant in our southern pines, and consequently the southern pines are easier to impregnate, especially with creosote. In some woods the resin ducts occur mostly in the summer wood. In others

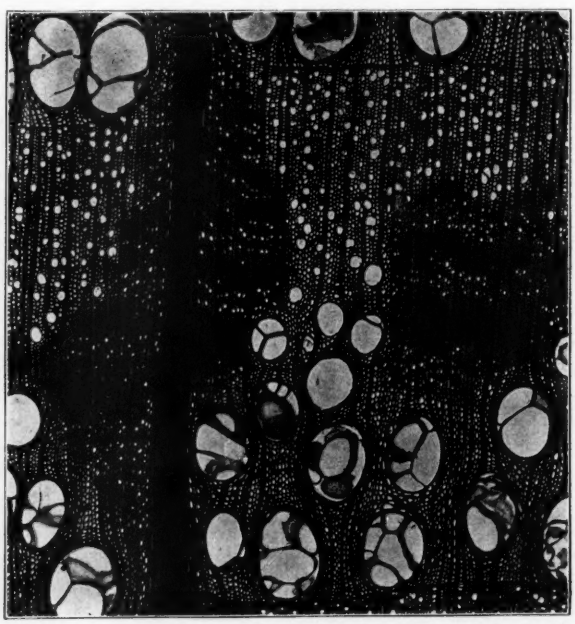


Fig. 8. Cross Section of White Oak, Cells Filled with Tyloses.

they occur mostly in the spring wood. This accounts for another peculiarity in treatment. Take, for example, the paving block. You will frequently find that it has been treated in streaks, the oil occurring mostly in the summer wood, with practically none in the spring wood. In certain varieties of wood these resin ducts and cells are entirely filled with resin which becomes hard like amber. This led me to believe that possibly we could get a better treatment in Douglas fir if we applied pressure and then released it, repeating this operation one or more times. That is, I argued if the cells were filled with resin, creosote being a solvent for resin, would dissolve it, and by alternately applying and releasing the pressure we ought to get a better penetration than by simply applying a pressure of 175 pounds and holding it until an absorption of eight or twelve pounds per cubic foot was obtained. When we first started these experiments we had considerable success. We succeeded in getting a deeper and better penetration in Douglas fir than by the old method of simply applying the pressure and holding it; but as we went a little further we found it didn't hold good. This method of treatment, if we may call it that, needs much further experimenting before it becomes of value. I think

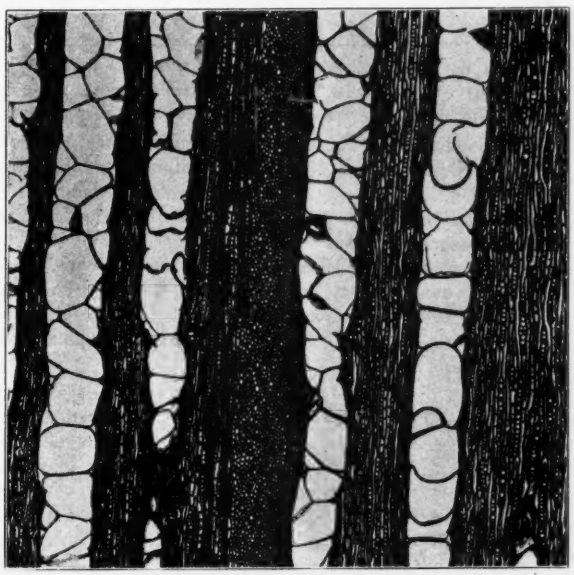


Fig. 9. Tangential Section of White Oak, Showing Tyloses in the Vessels.

you catch my point. Resin ducts normally retard the absorption of creosote when filled with resin, and the entrance of the creosote is blocked until that resin can be dissolved. Dissolving the resin ought to give a deeper penetration.

Figure 11 represents a piece of Norway pine which illustrates a point which, I think, will prove helpful to those who are called upon to inspect timber. The way you tell the age of a tree is to count the number of rings. But sometimes a tree will form two rings in one year. That may be caused by a drought or it may be caused by insect attack. The illustration shows a piece of wood that has formed two rings in one year. False rings can generally be told from annual rings by their imperfect structure, as shown in the figure.

Thickness and Character of Cells.

Now, we come to the third point. What effect does the thickness and character of the cell walls have on the treatment? For example, will a dense piece of wood treat harder than a wood which is very light and open-grained? At first thought one would say that it would, that the heavier a piece of wood the more difficult it would be to drive the preservative fluid into it, but, strange to say, the reverse seems to be true. Take, for example, a wood like white pine, which weighs only twenty-

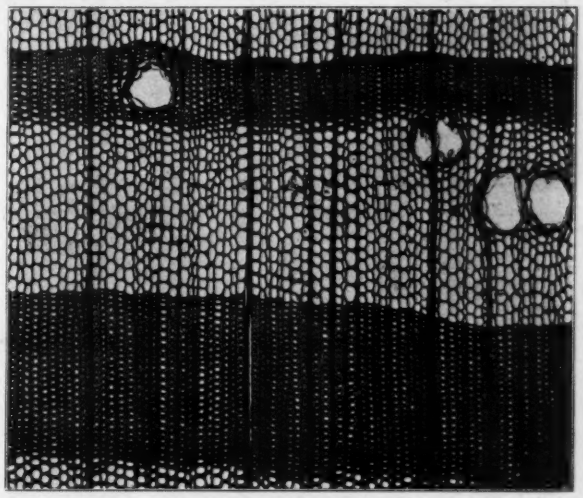


Fig. 10. Cross Section of Long Leaf Pine, Showing Resin Ducts.

five pounds to the cubic foot, air-dried, and compare it with a wood like longleaf pine, which weighs thirty-eight pounds to the cubic foot, air-dried, or yew, which weighs forty pounds, and you will find the white pine most difficult to treat, longleaf next and the yew last. We are not sure yet as to just why this is, but we have made certain observations which, if they can be developed commercially, are going to help considerably.

Figure 12 shows the cross section of the summer wood in Western Larch. The magnification you see must be ten or fifteen thousand. Notice the thickness of the cell walls and the checks in them. In green wood you don't get these checks, but the walls would be almost solid. I want to develop this point, for I think it is one which has commercial possibilities. In some tests in treating longleaf pine for paving blocks we found that the specific gravity of the spring wood, that is, the wood formed in the spring, was .389, and the specific gravity of the summer wood .95; in other words, nearly three times as much. The summer wood was, therefore, nearly three times as heavy as the spring wood. We forced creosote into these blocks and found that the spring wood absorbed only half as much creosote as the summer wood, although, as I stated, it was only about one-third as heavy.

Why is this? Here is a peculiar thing that happens. If you take a piece of wood and dry it out thoroughly, these heavy thick-walled cells will split. Figure 12 shows how they split. Such splitting does not occur to the same extent in the light thin walls, as they seem to yield and bend more under the read-

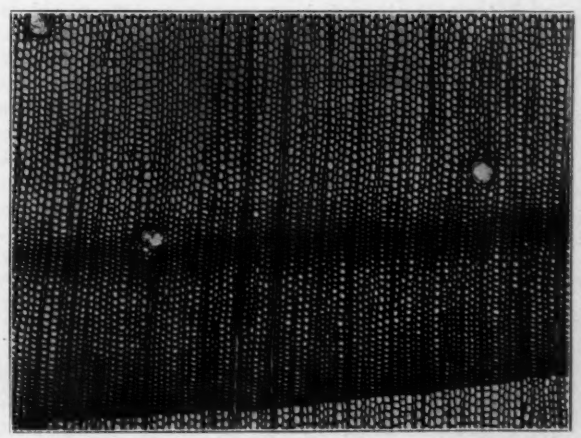


Fig. 11. Cross Section of Norway Pine, Showing False Rings.

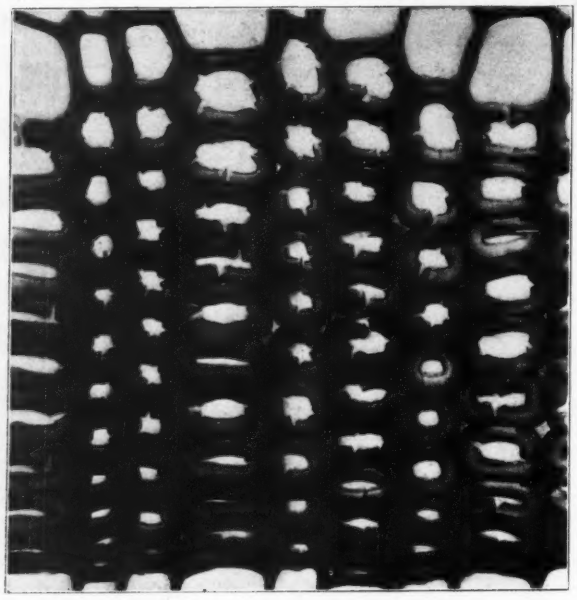


Fig. 12. Cross Section of Western Larch, Showing Slits in Cell Walls.

justment of the wood during drying. The heavy walls, it seems, therefore, cannot readily adjust themselves to moisture changes, and consequently split open somewhat in the manner of a tie when it dries too rapidly. Mr. Tiemann discovered this cell splitting and is now trying some experiments to see if it can't be performed on a commercial scale in a treating cylinder. If this can be done I see no reason why it won't be almost as easy to take a piece of white oak, for example, and treat it with the same ease we can a piece of red oak, because by splitting these cell walls open we develop channels for the creosote to get from one cell to another. These splits develop diagonally, so that they appear as cross marks on the walls when viewed longitudinally.

There is a possibility, therefore, before we attempt to drive the preservative into the wood, to first condition it, and if by conditioning it we can produce an effect like I mentioned, we might be able to take the most refractory woods and give them a good penetration.

There is one other element in wood structure that should be considered from the standpoint of penetrance. You notice on the cells shown in Figure 13 little round spots that look like targets. They are called "pits." They are like little doors, which open from one cell into another. When a tree is living the pits are guarded by means of a little trap. After the sap wood is converted into the heart wood these little trap doors are generally permanently closed, so that there is generally greater difficulty to force either air or liquid through the heart wood than through the sap wood. Now, it is possible, although we haven't succeeded yet in doing it, to break down these little doors, and if they can be broken down we would then have another means whereby the preservative can be forced from one cell into another. All these things are possible in the conditioning of the wood prior to the time the preservative is forced into it, but they await further development.

Another factor which undoubtedly affects the penetration of woods is the chemical composition of the cell walls. We know so little about this in relation to its penetrability by gases and liquids that I am not going to call it to your attention at this time.

Moisture Content.

We will now discuss the fourth factor affecting the preservative treatment of woods, namely, its moisture content. You all know it is easier to treat a piece of air-dried wood than it is a piece of green wood. One reason for this, as was shown by the illustration which I just gave you, is that cell walls split open when wood is seasoned below what is known as its "fiber saturation point." In green wood they remain solid. Water occurs in wood in two conditions: first, in the cells; and second, in the cell walls. If you take a green piece of wood and dry it out, the first thing you do is to take the free water out of it; that is, the water which is contained in the cells. If you continue drying it you will take the water out of the cell walls. Just as soon as you begin to take water out of the cell walls, just so soon do you begin to affect the strength of the wood, and not before then.

Figure 14 shows you the effect various moisture contents of several common woods have on their strength. Notice, for example, the chestnut. When chestnut contains twenty-six or more per cent of moisture it has a strength of about 3,000 pounds to the square inch. Now, it doesn't make any difference whether chestnut has sixty per cent or thirty-five per cent moisture, its strength will be the same, because you are simply taking water out of the cells. Just so soon, however, as you begin to take moisture out of the cell walls, then just so soon do you begin to affect the strength. Notice the increase. At twenty-six per cent moisture it has a strength of about 3,000 pounds, a ten per cent decrease in moisture will increase its strength to 6,000 pounds. In general, air-seasoned wood is from two to three times as strong as green wood.

How does this affect the wood preserving industry? It does so in this way: Suppose you have an untreated paving block and put it in a road bed. It is going to absorb water. It is going to absorb very probably more than thirty per cent of water; consequently, it is not only going to swell, but its strength is going to be lessened. An untreated paving block, therefore, is not going to last as long, is not going to be as resistant to wear, as a paving block which is thoroughly and properly saturated with oil, and which consequently has a much lower moisture content.

The curves in Figure 14 show the relationship of moisture to strength very well. The longleaf pine has a saturation point of a little over twenty per cent. That is, if we can take the longleaf pine block and reduce its moisture from 20 to 10 per cent, we should increase its strength from about 4,500 to nearly 9,000 pounds per square inch. In order to get good results, therefore, in the treatment of paving blocks, we want to get the oil scattered uniformly through them so that the moisture content will be kept at a practical minimum, thereby making the blocks more resistant to wear.

I want to show the progress of water evaporating from a

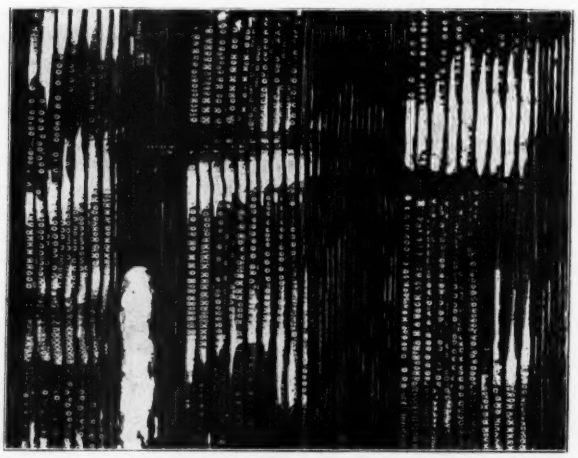


Fig. 13. Radial Section of a Pine, Showing Pits in the Cell Walls.

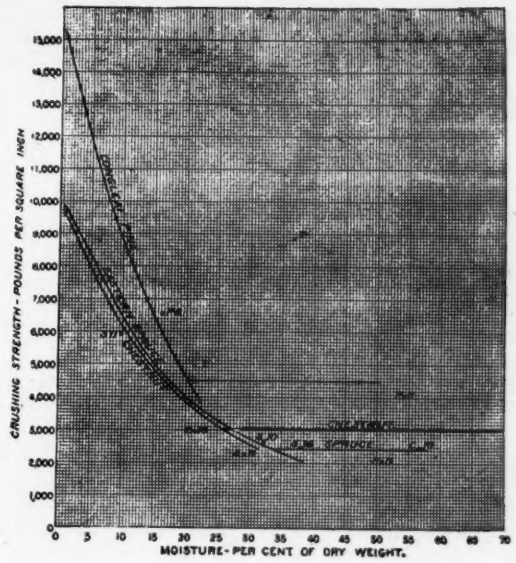


Fig. 14. Effect of Moisture on Strength of Wood.

plank while it is drying. Figure 15 shows a chestnut beam air-seasoned. The rubbing of some iron filing over it brought about the discoloration which appears as spots. The beam was cut into a number of sections and the dark spot shows the presence of water. You see that practically all the water is out of the end section. As we approach the middle of the beam the spots become larger, showing there is more water present. If you take a number of longleaf pine planks that have been piled in a yard and cut them into blocks, what are you going to find? You will find the planks on the outside of the pile in a drier condition than the planks on the inside. Furthermore, you will find the planks on the ends drier than in the middle. The result is that you will turn out blocks of varying moisture contents, as shown by this chestnut beam. No wonder some of them are going to take up more oil than others. This is one of the factors which affects the irregularity of the treatment of paving material. We made a few tests in this connection. We took some longleaf pine planks from a treating yard and sawed them into blocks. Upon examination the blocks cut from the ends of the planks had less moisture than those cut from the middle, and when put in the cylinder those cut from the ends took up more oil than those cut from the middle.

Now I want to go into a little theoretical discussion to bring out a few points which I think are of practical importance. Let us suppose that we have a cubic foot of wood in a green condition. We can consider that piece of wood as being made up of solid wood substance, water and air. If we assume the block to be shortleaf pine, about 31 per cent of its volume will be solid substance, 32 per cent will be water and 37 per cent will be air space. If we dry the block thoroughly we will get rid of the water, and we will have 31 per cent wood substance and 69 per cent air space. Now, what happens to this air in the wood during treatment? The greater the space filled with air, the more oil we ought to be able to get into the wood. A good many theories have been advanced in regard to this. Some claim that the air escapes from the wood during treatment and collects in the top of the treating cylinder; others claim that the air compresses in the center of the wood and forms pockets of compressed air; another theory is that the air is compressed in each individual cell, that it doesn't escape from the wood nor is compressed in the center; and still another theory is that the air compresses in pockets in different portions of the stick. We will consider these various theories.

In regard to the first theory. In our tests we have taken air-seasoned wood and put it into the treating cylinder and then filled the cylinder completely with oil. We had a glass receptacle on the top of the dome of the treating cylinder, so that if any air came out of the wood it would be caught in this glass cup and could be measured. We were unable in any of our experiments on air-seasoned material to detect that any of the air came out of the wood, and no air collected in the top of the glass cup.

In regard to the theory of air compression in the center of the tie or stick of timber. If this took place you should not get oil in the center of the stick. In treating red oak ties by the Rueping process, we first put in compressed air and then forced in the preservative, and on splitting the ties open found the oil had penetrated to the very center. If there had been a pocket of compressed air in the center, then we would not have had the center treated. But it was treated just as well as the wood only a few inches from the surface.

Concerning the theory of compression in each individual cell. It looks as if there might be much of fact in it. It also looks as if there might be a good deal in the theory that the air is compressed in pockets scattered through the wood.

Suppose now we upset this natural condition of the air in wood by means, say, of a preliminary vacuum, what is going to happen? Let me illustrate. Assume we have a treating cylinder and put into it some thoroughly air-seasoned wood. We then lock the door and quickly run the oil from the measuring tank into the cylinder, allowing the air to escape. When all the air has escaped and oil comes out at the top of the retort, we close the overflow valve and apply pressure. What happens? It depends largely upon the condition of the air in the wood, as shown in figure 16.

The three curves in figure 16 represent some preliminary work we have been conducting to illustrate this point. These results, gentlemen, are not final; they are yet purely preliminary, but we are going into this subject much more thoroughly. Notice the curve where we used no preliminary vacuum. When the oil ran into the cylinder it dropped in temperature, but before we applied pressure we raised the temperature of the oil to 180 degrees Fahrenheit. This took us a little over five minutes. Then we applied 150 pounds oil pressure to the square inch and held it there until we got an absorption of 12 pounds per cubic foot. As soon as we got the maximum absorption of 12 pounds per cubic foot we shut off the pump and opened the valve in the top of the retort. A rebound or a "kick-back" immediately occurred. The sudden drop in the curve will show you the amount which thus flew out of the retort; it will also show you the rate at which it came out. As soon as the oil stopped coming out of the top of the retort we drained the cylinder. As soon as the cylinder was empty we let the wood remain in the cylinder and kept weighing the drip from time to time. The gradual fall in the curve will show you the drip. In other words, without the use of any preliminary vacuum we pumped the oil directly into the wood and then released the pressure. Deducting the "kick-back" and drip, although there was originally about twelve pounds of oil per cubic foot forced into the wood, at the end of the treatment there remained slightly less than seven pounds.

In the second test we used a preliminary vacuum, which, of course, took some of the air out of the wood. We argued

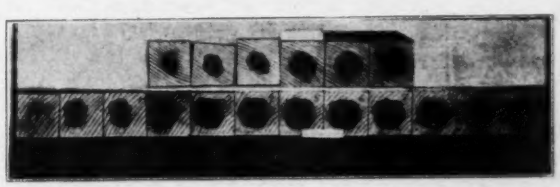


Fig. 15. Drying Process of a Chestnut Beam. Black Indicating Free Water in Pores of the Wood.

if we took the air out of the wood the oil ought to go in quicker, and less of it ought to come out on the release of the oil pressure. Let us see what happened. In the first place, the cylinder, after loading with wood, was under a vacuum of twenty-six inches. When the oil ran into it the temperature of the oil dropped further than it did in the first test, because the cylinder was colder. It took about fifteen minutes to heat the oil to 180 degrees Fahrenheit. We then applied pressure in exactly the same way we did before until we got an absorption of approximately the same amount. You will notice how very quickly the oil went into the wood. It took less than five minutes. After we got the desired absorption of about twelve pounds to the cubic foot, we opened the valve at the top of the cylinder as was done in the first test, and a "kick-back" of oil occurred, but it was not nearly as great as it was in test number one. Keeping the temperature, of course, the same, the retort was drained and the drip collected. By using the preliminary vacuum, therefore, air was taken from the wood and apparently more oil remained in the wood after treatment.

Then we tried one other test. We first filled the cylinder full of compressed air under 50 pounds pressure, and, without changing the pressure, pumped in the creosote. The pressure

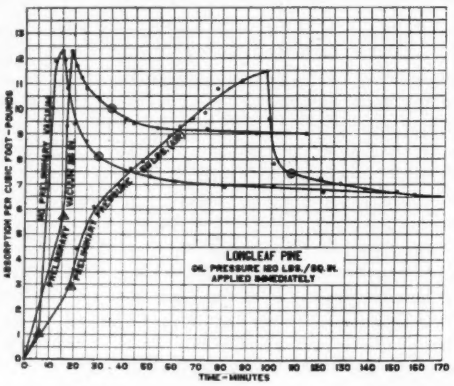


Fig. 16. Effect of Air in Cells on Absorption of Preservative.

on the oil was then raised to 160 pounds, and the pump kept going until an absorption of twelve pounds per cubic foot was obtained. Please compare the length of time it took to get the absorption in this case with the other two. It took one hundred minutes, five times as long as before because we were pumping against an air pressure in the wood. After the maximum absorption was reached the pressure as before was released. Notice the speed with which the oil came out. After no more came out of the top of the retort, we collected the drip.

What I expected to get, but didn't get, was a larger rebound of preservative. I don't know why it wasn't. One theory is, if you take creosote and pump it into wood cells, supposing that the air in each individual cell is confined, and the creosote is being pumped against it, you get a mixture of creosote and air under pressure, and under this condition the creosote will absorb air analogous to the way in which carbon dioxide is absorbed by water in the manufacture of seltzer waters. As I have mentioned, these curves are only indicative, but they indicated the effect air in wood has upon the rate with which the preservative can be forced into wood, the amount that can be forced in and the amount which stays in. Further tests now being made will increase their value.

Effect of Sap and Heart Wood.

I now bring up the fifth factor affecting treatment—the effect of sap-wood. Microscopically, there is very little difference between sap-wood and heart-wood. That is, a piece of sap-wood of, say, longleaf pine, looks about the same as a piece of heart-wood. From a structural standpoint there is also very little difference. That is, sap-wood is just about as strong as heart-wood, and for all practical calculations they are given the same strength, but from a wood preservation standpoint, there is a radical difference. You all know this so thoroughly it is not necessary to emphasize it. Sap-wood is very easy of treatment.

How does sap-wood affect the treatment of cross ties?

I had diagram 17 prepared to represent the cross sections of three different kinds of ties. The shaded portion representing sap-wood, the unshaded heart-wood and the black treated wood. It is generally said the more sap-wood a tie has the better it is for treatment. Is it? Suppose we put three ties similar to those shown in the diagram in a treating cylinder and treat them. What is going to happen? They are going to be treated like the black row of figures in the vast majority of cases. There will be a few exceptions, as in the case of red oak and ash, but for most ties what I say will hold true. Which one of these three ties, gentlemen, would you pick out as being the best for treatment? I think most of you would pick out this one, with the small heart in the center; then your next choice would be the pole tie; and you would leave the sawed heart tie as the last choice. Most of the operating men whom I asked replied in this way. I think the first choice is correct, but I think the others are not. If you put a tie into a road-bed and subject it to use this is what will happen: It is going to wear on the face, and it is the face which needs greatest protection. With the pole tie shown in the figure the face is protected by only a thin film of preservative. What good is heavy injection going to do on the sides in this sap-wood, although it is simply saturated with oil, say, twelve pounds per cubic foot? Most of it is practically wasted, because it isn't where you want it. I might compare this condition with a house built of granite walls and a paper roof. As long as the paper roof lasts and doesn't leak, the interior of the house will be all right, but as soon as the roof leaks the house becomes practically valueless. So with the tie; it is going to rot in the interior, and what good will the protected sides be, even though they never would rot? Wouldn't it be better to cut off some of the sap-wood and use a sawed tie, distributing the oil more uniformly?

If the railroads would not discriminate against sawed ties they would increase the production and manufacture of sawed ties, and, in my opinion, it would be possible for them not only to conserve our future supply of timber, but to save thousands of dollars as well.

Let us consider this for a moment from a financial viewpoint. Suppose we are operating a treating plant of two cylinders 7 by 132 feet, turning out 800,000 ties a year. Suppose that our creosote costs us six cents a gallon; suppose that we will treat pole ties, hewed on faces only, and our specifications call for an injection of ten pounds of oil, we will say, to the cubic foot, or thirty pounds per tie. The plant would consume in a year's operation about 24,000,000 gallons of oil. If, now, we specified ties like number 2 instead of number 1, and we could get ties like number 2, we could, I think, by using only six pounds of oil to the cubic foot, get just as long a life, and just as good results as we did before. In other words, we could save about four pounds of oil to the cubic foot, or twelve pounds per tie, in operation, and at six cents per gallon that would mean a little over nine cents a tie. Nine cents a tie for a plant operating 800,000 per year means about $72,000.00. This, of course, is an extreme case. I picked out an extreme case purposely. This is a question, perhaps, more for the railroad companies to consider than it is for the wood preserving plants. Railroad companies ought to pay more attention unquestionably to the manner in which their ties are manufactured. They can afford to pay three or four or more cents a tie for properly manufacturing them and save money by it. The saving in extreme cases may amount to seventy thousand dollars a year in the operation of a single

plant. Is it not worth your while to pay more attention to the kind of ties you are getting and the manner in which they are manufactured?

Effect of Bark on Absorption.

Now we come to our last factor affecting treatment, namely: the effect of bark. This in another point which apparently is under dispute. Why did nature put bark on trees? Largely to protect them against evaporation. If a tree didn't have bark on it the water would all evaporate before it got to the top. But bark is a water-proofing cover which in certain varieties, notably the pines, is absolutely impenetrable to liquids, even under a pressure of five or six hundred pounds to the square inch. Bark, therefore, exerts a very retarding effect on the seasoning of timber.

The lower illustration in figure 18 represents a section of short leaf pine tie that was cut in Birmingham, Alabama, and

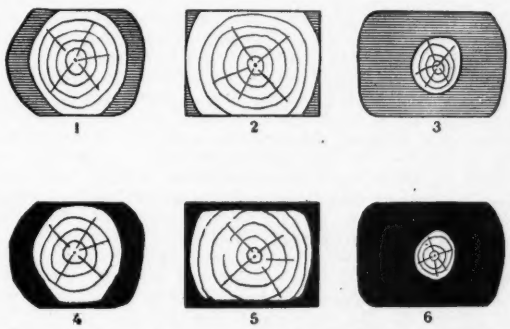


Fig. 17. Effect of Sap Wood on Absorption of Preservative.

seasoned with the bark adhering. Before it went into the treating cylinder all the bark was taken off. Look at the way it is treated. Here is a sort of V-shaped zone of treated wood which had become well seasoned. The sap wood being much easier to treat than the heart wood, caused a band of treated wood about one inch wide to extend down the sides of the tie.

This upper photograph in figure 18 represents a loblolly pine tie which was peeled and seasoned with the bark off, but in peeling it a little piece of bark about as thick as paper was left. When the tie was treated a streak of untreated wood ran from the outside to the inside. This means that with certain kinds of wood we have to be very particular to peel off the bark, however, with other kinds of wood it doesn't make any appreciable difference.

Some work we have been doing along this line will explain this further. We took blocks of wood and bored holes into them exactly an inch in diameter, and forced the creosote into these holes. As you know, the pressure on the oil was distributed uniformly in all directions. We held the pressure for half an hour or so, and then removed the blocks and ripped them through the middle and then across. This enabled us to study the penetration in various directions. The ratio of penetration will vary about as follows: In woods like the tamarack and white fir, if the oil goes in one inch—as a matter of fact it goes in about one-sixteenth of an inch in ordinary treatments—but if it goes in one inch tangentially it will go thirty-five inches radially, and fifty times as far longitudinally; that is, it will go fifty times further with the fiber than it will in tangential direction. Now, in woods like hemlock we get even a greater difference. Suppose that the oil goes in one inch radially, tangentially it will go in about an inch, but in the longitudinal direction it will go from 80 to 100 inches; in other words, from 80 to 100 times as far through the ends as through the sides. This, I think, illustrates the relative resistance of woods to treatment in the radial tangential and longitudinal directions.

There is one other point that I want to bring up which I think will be of interest to you. We have been carrying on some investigations on this problem of penetrance using zinc chloride as well as creosote. You all know that it has been difficult, if not impossible, to tell how far the zinc chloride has penetrated the wood, unless some chemical analysis or test was used. By heating for a few hours a piece of wood freshly treated with zinc chloride at a temperature of about 215 degrees Fahrenheit, that portion of the stick containing zinc will be turned a deep brown. This fact was discovered by Mr. Workman while he was conducting some tests in the Forest Products Laboratory in connection with some of our experiments. I call it to your

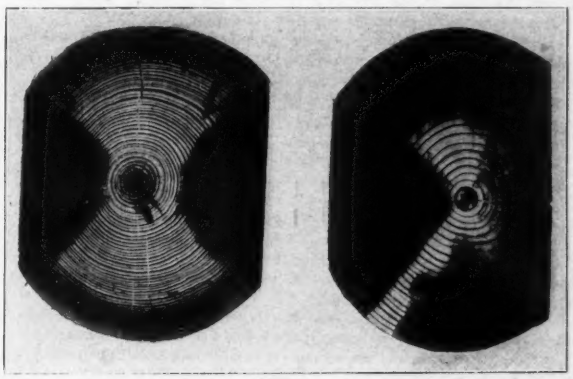


Fig. 18. Effect of Bark on Penetration of Preservative.

attention because it looks as though it is an exceedingly easy, simple and practical way of finding out the depth to which zinc chloride penetrates wood.

ELECTRIFICATION OF MELBOURNE RAILWAYS.

The latest large city of the world that has decided upon electrifying its suburban lines is Melbourne. The government is about to proceed with work on 200 miles of line, after deputing a commissioner to examine and report on the principal systems in both Europe and America. Though the density of population in Melbourne is not great, being only 2,000 per square mile as compared with 9,600 per square mile in greater London, the city is a very large one, holding some 40 per cent of the total population of Victoria, whereas, London holds only 20 per cent of the population of England. Its tramway system is a cable line and thus has not proved a serious rival to its railways so far, the railways carrying about one-half of the total suburban traffic. It is expected, however, that electrification will attract another 10 per cent of traffic, and as it already pays handsomely the cost of electrification will soon be recouped. Tenders are at present being invited on both the alternating and direct-current systems and it is believed the form of coach used on the Brighton railway will be adopted and that the power station will be run by steam turbines.—Indian Engineering.

TELEPHONES ON THE WABASH.

It is said that the Wabash will this year do a great deal in the way of telephonizing the several lines that go under its name. It is said that about 1,600 miles of copper wire will be strung between Decatur and Detroit, St. Louis and Moberly, and St. Louis and Chicago. This wiring will be exclusively for the use of telephones, which will be used for the purpose of operating the trains. The amount that was authorized for the work was $100,000 but it is said that the work can be done at a figure of about $15,000 under this.

RAILWAY ENGINEERING ASSOCIATION REPORT.

TIES.

Tie Renewals in Continuous Streches Versus Single Tie Renewals.

The following list of questions was sent out to determine the practice with respect to the renewals:

"(1) What is the practice of your road in renewing ties; tie renewals in continuous stretches or single tie renewals?

"(2) Do you think it advisable to renew ties in continuous stretches?

"(3) What would be the advantage of this latter method of tie renewals?

"(4) What are the advantages or disadvantages of single tie renewals?

"(5) Which practice would you recommend?"

Mr. E. J. Correll, Engineer Maintenance of Way, Missouri Pacific Railway:

1. Single tie renewals.
2. No.
3. I know of none. Would consider it a disadvantage.
4. Disturbs the surface less, is more economical and makes condition of track more uniform.
5. Single tie renewals.

Mr. Robert Trimble, Chief Engineer Maintenance of Way, Northwest System, Pennsylvania Lines:

1. The practice of our road is to renew only such ties as will not last another year. This, I take it, is what is termed "single tie renewal."

2. No. By doing so the life of the tie is considerably shortened. It is known that a tie when left in place will last longer than if taken out, thrown around, loaded and unloaded, and then put in somewhere else. The chances are that many ties which would last another year or two if left in their place, would be wasted and not used elsewhere.

3. I know of no advantages of renewing ties in continuous stretches that would even compensate for the disadvantages.

4. Advantage of single tie renewals is the resultant economy. I know of no disadvantage.

5. I recommend single tie renewals.

Mr. J. B. Berry, Chief Engineer, Rock Island Lines:

1. Single tie renewals.
2. Not unless they are all decayed or worn out so that they need to come out at the same time.
3. I know of none.
4. I believe the economy of a railroad demands that no tie should be taken out until decayed or worn out. The men along the line are educated to better rules of economy by adopting such methods, and you never can keep all ties, even if you lay them in a continuous stretch, in the same condition so that they should all be taken out at the same time.
5. I favor only taking ties out as stated above.

Mr. L. R. Zollinger, Engineer Maintenance of Way, Pennsylvania Railroad:

1. Single tie renewals—method known as "spotting."
2. By no means.
3. There is no advantage.
4. Advantage of single tie renewal is economy, permitting of ties remaining in that are too good to come out, based on the knowledge that all material is not the same and does not have the same lasting qualities, and permits of removal of those ties, the lives of which are not up to the average, when they become unfit for use.
5. We recommend the practice of "spotting."

Mr. J. M. R. Fairbairn, Assistant Chief Engineer Eastern Lines, Canadian Pacific Railway:

1. It is our practice to make tie renewals only as they require it.

2. Would not consider it economy to renew in continuous stretches and see no advantage gained by this method. It is our practice in the spring of each year to send a man, well versed in tie conditions, over each sub-division, and he marks with paint the ties he considers not good for another year's service, using proper judgment and taking into consideration condition of adjoining ties. These are replaced during the summer season and if a section foreman considers that a tie has not been marked which, in his opinion, should be replaced, he takes matter up with the roadmaster, who decides whether or not renewal will take place.

3. Only advantage is that it entails less work.

4. Advantages of single tie renewals are that only those ties are removed which have served their life. In the other case ties are removed which have another year or two of service in them, so that in renewing in continuous stretches, there is, therefore, more waste.

5. I, of course, recommend the single tie renewal system.

Mr. S. A. Jordan, Engineer Maintenance of Way, Baltimore & Ohio Railroad:

1. Our practice is to renew only those ties that will not last another year.

2. No. Our ties are inspected every spring by a regular tie inspector, who marks all ties that are to come out.

3. Do not think there is any particular advantage.

4. Believe that renewals as made by the B. & O. are better than in continuous stretches. By taking out only such ties as will not last another year you get a uniform amount of good timber under your rail.

5. I recommend renewing ties singly.

Mr. W. C. Cushing, Chief Engineer Maintenance of Way, Southwest System, Pennsylvania Lines:

1. The practice of our lines is to renew ties as worn out or decayed, and not in continuous stretches.

2. No, except, possibly, between station platforms or in street crossings where the labor of getting at the ties is great.

3. I believe the following advantages might be claimed for the method of renewing in continuous stretches: (1) Track could be given uniform lift, and, when new ties were in place, uniform support would be furnished them; (2) Cost of laying in continuous stretches would probably be less than laying them singly.

4. Advantage of single tie renewals are: (1) The track, as a whole, is kept in a more uniform condition, as to the quality of the supporting ties; (2) Only ties that should be removed, account of wear or decay, need be removed. Disadvantages of this method are: (1) The old bed of the tie must be dug up to get the new tie in place, or entire track given sufficient raise to accomplish this result: (2) Where platforms, planking or interlocking fixtures must be disturbed to remove ties, this disturbance takes place oftener under the single tie renewal system; (3) The cost of renewal per tie is probably somewhat higher under this system also.

5. We would recommend the renewal of ties singly. Because: (1) The general safe condition of the track is greater; (2) The average life of the ties, we believe, will be lengthened by the single tie renewal method, as, when renewing in continuous stretches, many ties are necessarily taken out and lost which might safely be left in the track a year or two longer if the adjoining ties were good.

Mr. M. C. Hamilton, Engineer Maintenance of Way, New York, New Haven & Hartford Railroad:

1. It is our practice to renew ties singly.

2. This depends on the local conditions; on four-track sections interior tracks, or adjacent to station platforms, the renewing of ties "out of face" is considered the economical practice.

3. We do not consider the renewal of ties "out of face" the economical practice under normal conditions.

4. Advantages of single tie renewals are greater economy and more uniform condition of track.

5. I would recommend the renewing of ties singly, except where unusual conditions demand the other method.

Mr. C. M. James, Engineer Roadway, Atlantic Coast Line:

1. The practice of our road is single tie renewals.

2. Under the conditions existing in this territory, I do not think it advisable to renew in continuous stretches.

3. The advantage of the above method is in the saving of labor, but this advantage is outweighed by the disadvantage that material is used.

4. Advantage of single tie renewals is in the fact that full life can then be gotten from each individual tie.

5. There is no question in my mind but that single tie renewals is the better practice.

Mr. G. J. Ray, Chief Engineer, Delaware, Lackawanna & Western Railroad:

1. Single tie renewals is the method practiced as much as possible. We find that some of our old foremen have been in the habit of renewing ties in continuous stretches, and it is hard to break them of this practice, and there are cases where we permit this method of renewal through station grounds where it is more difficult to get at the track, making use of the better ties taken out for sidetrack purposes.

2. No. If all the ties are in such shape that they should come out, I do not think the track is in first class shape, and am not an advocate of permitting track to get in such shape that all ties can consistently be taken out at the same time.

3. Only advantage is that more ties can be placed at the same cost.

4. Full life of service can be gotten out of every tie, and this advantage of single tie renewal will more than outweigh any advantage in favor of the former system.

5. Single tie renewals.

*Some additions to the report on this subject in the April issue of "Railway Engineering."

Mr. W. L. Breckinridge, Engineer Maintenance of Way, Chicago, Burlington & Quincy Railroad:

1. We practice the system known as "single tie renewals."

2. No, except in special cases.

3. Only advantage I know of in renewing in continuous stretches is in cases where the life of the rail under heavy traffic about equals the life of the ties; that is, in renewing rail where the traffic is heavy, ties should be renewed in full and unless ties under old rail are almost new, they should all come out. You will then have a track which will not have to be disturbed during the life of the new rail on account of tie renewals.

4. Single tie renewals is all right, especially on less important main lines where the life of the rail exceeds that of the tie. We are also able to keep yearly check on our gage and hold track to a more perfect gage, since the average efficiency of a proper single tie renewal track is almost constant, while with a continuous renewal track the holding power of spikes and general efficiency is on the decrease. Disadvantages of single tie renewal are: (1) Frequent disturbance of roadbed; (2) Inability to get a firm and equal bearing on the new ties; (3) Taking up too much time in the spring for this sort of work when the track needs picking up; (4) Keeping right of way littered each year with new and old ties.

5. I would recommend continuous renewal only when relaying rail on main line heavy traffic road. In such cases the life of the rail does not exceed that of the ties. In all other cases I recommend single tie renewal, as the life of tie timber varies too much to consistently renew in continuous stretches.

Mr. W. J. Towne, Engineer of Maintenance, Chicago & Northwestern Railway:

1. Tie renewals based upon actual condition of tie, except joint and center ties; these are usually renewed together, and if any ties removed are serviceable elsewhere, they are properly utilized.

2. No, not as a general proposition. In slag or rock ballast I think it economy to renew continuous to the extent that any ties that will not last 2 years or more be taken out.

3. Principal advantage would be in securing more uniform rail bearing and economy when the life of the tie would not offset the labor charge for renewal and less disturbance of track bed result in general economy, in rail, etc., as well as improved roadbed.

4. Advantage of single tie renewals consists wholly in conservation. Disadvantages mentioned in reply "three."

5. Depends on character of line, volume of traffic, ballast, rail and roadbed. In gravel ballast with light traffic would recommend single tie renewals; in rock or slag ballast with heavy traffic would recommend renewal joint and center ties together, and renewal of all ties that would not last 2 years, both as a matter of economy and other reasons before named.

Mr. E. F. Mitchell, Chief Engineer, Missouri Pacific Railway:

1. Single tie renewal is the practice of our road.

2. No, we do not think it advisable.

3. The average life of a tie on this system is 8 years. For the sake of argument assume that the best method of renewing ties in continuous stretches would be to renew all the ties under 1 rail length in a given year at one time. Then about 6 years later it would be necessary to renew at least a portion of these ties, possibly 50 per cent of them. The balance of ties under this rail would probably last from one to four years.

5. If the ties rotted at the end of 6 years are not "spotted in" or renewed, as called, in single ties, but, instead of this the entire rail length is renewed for the purpose of reducing the cost of labor for renewal per tie, then about one-half the ties under this rail will be renewed when they have from one to four years' service left.

Mr. W. D. Taylor, Chief Engineer, Chicago & Alton Railway:

1. Single tie renewals, except where there are 2 or more consecutive ties to be renewed.

2. Only when renewing in track to be surfaced, as we do not think it advisable to leave old ties in track that is being surfaced, and then have to again disturb the track and ballast the next year to change out the remaining old ties.

3. Advantage of single tie renewals is that fewer tie renewals are required to keep track in good condition where only the worst ties are taken out and new ties put in in this way than would be the case where long stretches of ties are taken out, and the track shaken up and ties knocked around for spacing.

4. and 5. Answered in the above.

Mr. F. R. Layng, Engineer of Track, Bessemer & Lake Erie Railroad:

1. Single tie renewals.

2. No, I do not think it advisable to renew in continuous stretches.

3. The cost of renewals per tie (labor only) would be less when ties are renewed "out of face." This is on account of the fact that only about half as much ballast per tie would have to be dug out to make renewals. Disadvantage: In renewing in stretches, when it is decided that renewals should be made, track is in weakened condition. This being so, chances are either taken to run the ties a little longer, or, if the responsibility rests with a man who is timid, renewals are ordered at a time when most of the ties would last two or three years longer, if not disturbed. Neither of the above conditions tends to good practice. The ideal, to my mind, is to get the longest possible life from a tie, consistent with safety, without disturbing it.

I am quite sure the tendency of the average man would be to remove the ties in ample time so that the result would be to reduce the life per tie to about five years. This would increase the cost of tie renewals from 15 to 20 per cent. Inasmuch as tie renewals make up the largest single item in maintenance expense; most roads would hesitate to increase same unless some very decided advantage resulted therefrom.

Another disadvantage: It is practically impossible to select ties which would decay so uniformly that any great length of track could be renewed without taking out some ties still fit for service. Some use would have to be found for these ties and they would no doubt be used in sidetracks. Assuming the following:

Cost of first-class tie delivered along track	$0.70
Cost of second-class tie delivered along track	.60
Average life of first-class tie in main track	7 years
Average life of second-class tie in siding	7 years
Average life of first-class tie removed from main and used in siding	3 years

We arrive at the figures given below:

Cost of tie removed from main and put in siding 3 years at 10c per year	$0.30
Cost to remove from main track	.03
Cost of putting in siding	.08
Total cost	$0.41
Average cost per year in siding	$0.13 2/3
Cost of second-class ties	$0.60
Cost of putting in siding	.08
Total cost	$0.68
Average cost per year in siding	$0.09 5/7
Cost of first-class tie in siding	$0.70
Cost of putting in siding	.08
Total cost	$0.78
Average cost per year in siding	$0.11 1/7

The above shows clearly, if my assumption is correct, that it does not pay to use same in sidings.

4. Advantages of single tie renewals: (1) Effective life of tie is longer; (2) Average condition of track as to safety is better; (3) Single track renewals disturb roadbed less; (4) Trackmen can arrange work to better advantage in single tie renewals; (5) Cost of tie renewals considerably in favor of single tie practice. (Net cost, including everything connected with this item.)

Disadvantages: I can see no particular disadvantage in the method of renewing ties singly. The most expensive thing we have is labor and least amount of labor per tie is expended.

5. Usual argument against single tie renewals, I presume, is that after making same, track does not ride smoothly or is spotty. Now this is usually the case, but it is the result of poor maintenance and is not a necessary evil which follows the practice of single tie renewal. If the trackmen will properly tamp new ties a week or ten days after they have been put in, this trouble can easily be taken care of.

Mr. J. E. McNeil, Inspector Roadway and Track, Atchison, Topeka & Santa Fe Coast Line:

1. Our practice is single tie renewals.

2. Not advisable on our line, at least, where there is so much difference in the length of time our ties last.

3. There would be no advantage on western lines.

4. We find that the life of tie timber received at the same time and cut in the same forest varies from one to five years. To make tie renewals in continuous stretches would, we think, be extravagant. At one time in the Middle West where we got eight years' service out of our white oak ties, and the inspection was such as to have them about the same in quality, we figured on renewing about one-eighth of the number each year. In this way the work could be done with a small extra gang.

5. In this part of the country where we have such a variety of tie timber and their lasting quality is so different, I would recommend single tie renewals.

Mr. G. B. Owen, Engineer Maintenance of Way, Erie Railroad:

1. The practice of this road is to renew ties singly.

2. Do not think it advisable to renew ties in continuous stretches.

3. I cannot name any advantage of renewing ties in continuous stretches.

4. The advantage of single tie renewal is economy and uni-

formity in maintenance, and uniformity of track conditions as well as maintenance charges.

5. I would recommend an inspection by a competent inspector of the old ties in the track before renewal, and that only such ties be removed which would not give one additional year's service from the time the inspection was made. This practice, if continued from year to year, will result in a stronger condition of the roadbed with the employment of a less number of men per section than would be necessary where continuous renewals were made. It would also materially assist the purchasing department in the placing of their contracts for ties. The disadvantages which developed from our tests in continuous tie renewals were that a large number of ties were removed which would give one, two, three or four years' further service. An effort was made to utilize these ties in other tracks, but it is manifestly a great loss of labor to remove a tie until it has worn out and then attempt to again replace it in the track. A further disadvantage resulted in an effort to reduce the forces on sections where continuous tie renewals were made in order to make up, in a way, the excessive cost of these renewals. In a very short time this reduction resulted in bad surface and line so that in the end there was really no saving in labor.

From the excellent information received it is evident that the general practice is to renew ties singly, except in unusual cases at station platforms, highway crossings, narrow tunnels or interlocking plants where it requires much labor to get at the ties or to uncover them for the purpose of renewal.

Metal, Composite and Concrete Ties.*

Cleveland, Cincinnati, Chicago & St. Louis Railway:

(See Vol. 11, Part 2, page 887; Vol. 12, Part 1, page 383.)

On August 28, 1911, Mr. C. A. Paquette, Assistant Chief Engineer, advised: "Answering your letter of the 26th instant, we have no additional information to give you as to steel ties which are in service in our main track.

"In November, 1909, there were 20 concrete ties made under the Israel patent and put in the main track east of Paris, Ill., on our St. Louis division. On February 12, 1911, we found it necessary to remove three of these ties from the track, the ties having failed completely. The concrete was crushed and the top plate, which reaches half way across the tie and serves as a support for the rail fastenings, was broken in several places. As to the balance of the ties 85 per cent of them have the top plate either cracked or broken.

"This experience seems to indicate that these ties are not suitable. Their life may be considered to be about two or three years, and the cost is considerably greater than that of wooden ties."

Cornwall & Lebanon Railroad:

On October 16 Mr. A. D. Smith, President and General Superintendent, advised as follows:

"With reference to our experience with the 200 Snyder steel ties which were installed in our road about five years ago, these ties are located on the southbound track of our double track, lying about one mile west or south of Mount Gretna in a 2-degree curve and on a 1.5 per cent descending grade. One coat of tar paint was applied when the ties were put in and another coat during the past year. This is about the only expense we have been put to in the matter of maintenance.

"A few months ago in passing over this part of the road it was noticed that the asphalt concrete filling showed signs of disintegration at the open ends of the ties and upon investigation we found as far back as the hand could be placed that the filling was loose and in particles. In order to ascertain how far in this extended, the tie was taken out of the track and in pulling the tie out the filling was left on the ground under the rails, simply a mass of particles. We imagine that as a result of this condition whenever the ties are tamped some material will be dropped from the bottom through the slight raising due to the tamping. The track foreman reported that he had noticed the material loosened in this manner several months ago. The track at this point is laid with 80-lb. rail and on stone ballast.

"Approximately half a million tons of freight per year pass over this track in the southward direction, our heaviest locomotives being 75 tons in weight, not including the weight of the tender. During the summer season eight or ten passenger trains pass over this track daily and four passenger trains the remaining portion of the year, probably at a speed of 40 or 50 miles per hour.

"There has been no trouble at all in connection with these ties as stated, except the recent crumbling of the asphalt filling. Just what the effect of this would be eventually we are not prepared to say."

Mr. W. A. Clark, Chief Engineer, advised August 28, 1911, that he has nothing additional to offer. "The ties covered by our last report are still in the track and giving satisfactory service."

*Some additions to the report on this subject in the April issue.

Duluth, Missabe & Northern Railway:

Mr. H. L. Dresser, Chief Engineer, under date of September 11, 1911, writes as follows:

"Your letter of September 8, in regard to a report as to the steel ties which we have in use on our line; we have about 22,400 ties of the Carnegie Steel Company's Section M-21. They were purchased in the summer of 1908 and we started to put them in the track in the fall after the ore business closed, but the work was not completed until the spring of 1909. Two miles of these were placed on the hill between Duluth and the yards at Proctor, being placed in the double track, one mile in each track. This portion of the road had been previously ballasted with crushed granite and consequently required less work to place them than it did the others, which were placed where the track crosses the big muskeg swamp about fifty miles north of Duluth. This is also double track and we have two and one-half miles of these ties in each track. This portion of the road had been ballasted with gravel and had always cost us a great deal to maintain during the summer season on account of the nature of the soil underneath the roadbed. It was necessary to keep the track lined with men during the ore season to keep the track in shape and to keep the rails spiked to line, although we were using tie-plates, but owing to the shaking and trembling of the ground underneath which set up a vibration in the train the rails were continually spreading and it was necessary to line spike this track every season, and more or less would have to be lined up two or three times during the summer.

"We removed the old ballast and replaced it with crushed granite, leaving the original roadbed underneath the granite sloping from the center between the two tracks. Owing to this work having been done in the winter when there was a great deal of snow on the ground and more or less ice, these tracks required considerable attention during the summer of 1909, but by the time winter set in we had these tracks in elegant shape, and during the summer of 1910 we did no more work on them whatever. Of course, the section men passed over them going to and from their work, but no work was done in either surfacing or lining during the entire summer, which was something very unusual for that track. It kept in very good shape until late in the fall, at which time by careful inspection you could see that some places were slightly depressed, but it was scarcely noticeable in the running of trains. Early in the season of 1911 we sent an extra gang over this track and brought it to surface again. Since that time no work has been required on it, although we have had a large amount of rain in that district this summer.

"We would say that with these ties, placed 18-in. centers as we have them, carrying 100-lb. rail, it is impossible for a small section crew to line and surface the track to a great extent, but needs a small extra gang to handle it, as it is exceedingly heavy and hard to move. However, it requires so much less attention than our old track with the wooden ties and 80-lb. rail that we feel there is economy in the use of these ties, notwithstanding the difference in first cost of the steel and the wood, and would like very much to have them to place on the entire length of the main line, but as our tracks run through a forest most of the way where the settlers are getting out track ties more than any other material and ship them over our road, our people feel that we ought to use their product while it lasts, as it will be but a very few years before all timber for wooden ties lying anywhere near our road will have been used up.

"The two miles on the hill between Duluth and Proctor have required scarcely any attention since they were put in place, but the soil underneath the roadbed at this point is solid clay and has never caused the trouble the tracks across the big swamp have. There are two light curves on the latter two miles and we have worn out the new rail which was placed with the ties in some instances on these curves, but the cost of surfacing and relining the track has been very light as compared with the tracks on the wooden ties.

Elgin, Joliet & Eastern Railway:

Mr. A. Montzheimer, Chief Engineer, advises as follows: "We have put in this year 500 Carnegie Steel Company ties. These are located on the main line, between Gary and South Chicago. We are now making up list of switch ties for next year and expect to be able to make our next year's renewals of switch ties, consisting of about 350 sets, with Carnegie steel ties. In addition to above we are planning to use Carnegie steel ties on all renewals on main line curves."

Erie Railroad:

On October 7, 1911, Mr. W. J. Harahan, Vice-President, advised as follows: "No further installation of metal ties has been made since the report of November 30, 1910, was made, and therefore the Carnegie steel switch ties at Bergen are the only ties of this character in use. In regard to these ties, would advise as follows: The original 57 ties are still in service. One of these ties was broken off outside the rail and fastenings by derailment of a car August 30, 1911. The derailment was caused by yardmaster

not getting the switch over in time. Otherwise, these ties are practically as good as new.

"In regard to the fastenings supplied with these ties, they are too small for the service required of them, and as the effect of rust on them is very great, they soon fail and have to be renewed. The fastenings on these ties have all been renewed once, and some of them twice since the original installation was made, which was in April, 1909.

"As regards the desirability of these steel switch ties compared with ordinary yellow pine switch ties, would state they compare favorably, except in the matter of fastenings, which feature could be improved very much by the use of heavier bolts and clips, and lohmanized material."

Galveston, Harrisburg & San Antonio Railway:

(For previous reports see Vol 11, Part 2, page 894.)

Mr. D. K. Colburn, Engineer Maintenance of Way, advises that they have installed 200 Percival Reinforced Concrete Ties, 100 at Bayou Sale, La., January 20, 1910, and 100 at Edgewater, Texas, October 22, 1906.

At Bayou Sale the ties were installed under 76-lb. rail, gravel ballast. Traffic at this point low speed and rather heavy. The ties are located at end of double track where fires are cleaned and the concrete ties are thus far satisfactory in all respects, except that the wood cushions under the rail have been somewhat damaged by fire, but their renewal is an easy matter.

At Edgewater the ties are under 80-lb. A. S. C. E. rail gravel ballast. Fifty ties at this point were installed consecutively, 18 ties to a 33-ft. rail, and 50 were placed alternately with cypress ties. Traffic over these ties is high speed and rather heavy, and at the time of making this report (September 7, 1911), they were in good condition, except for a few minor cracks.

In regard to shape of this tie the patentee, Mr. Percival, advises that the tie is made wider at the top than elsewhere and of somewhat rounded bottom for the following reasons:

1. For easy tamping.
2. Economy and better utilization of reinforcement.
3. For reduction of section and consequent weight.

Mr. Colburn further advises that these ties are made up as follows:

Composition: Six parts clear granite crushed very fine. Two and one-half parts crushed sandstone (largest piece passes through a one-inch ring). Two parts Whitehall cement.

Reinforcement: Three ½-in. corrugated bars in face. One ¾-in. corrugated bar in base.

The bars are bound together with strong wire, making a truss; total weight of reinforcement 25 lbs., total weight of tie 445 lbs., cubical contents of tie 3.385 cu. ft.

Lake Short & Michigan Southern Railway:

(See previous reports, Vol. 10, Part 1, page 511; Vol. 12, Part 1, page 384.)

On September 20, 1911, Mr. Samuel Rockwell, Chief Engineer, advised: "At one time we had steel ties on several divisions of the road in experimental stretches, but a few years ago they were all taken out. One of the chief troubles we had with them was the insulation. A number of them have now been put in on our Sandusky pier branch where the speed is limited, and we have no need of insulation, and where we run in streets part of the way and good permanent construction is needed. They are well adapted for this service.

"These ties are mostly of the Buhrer pattern, made by the Carnegie Steel Company, with four clip fastenings for each tie. They have been in track for about six years and are in first-class condition at this time. The roadmaster is of the opinion that they will last from ten to fifteen years longer. They hold the track in line, surface and gage very well, but our people are not yet convinced that they are the tie for our main line with its heavy high speed traffic."

Northern Pacific Railway:

(See previous report, Vol. 12, Part 1, page 384.)

On August 30, 1911, Mr. W. C. Smith, Chief Engineer, Maintenance of Way, advised: "We have made no additional installation during the past year. In fact, we have removed a few of the metal ties and transferred some to other points so as not to conflict with automatic block signals which we have been placing. We are finding it very difficult to properly insulate them. The few ties which we have in place have given excellent satisfaction. We are simply using them at a number of points where engines take coal and water, and where cinders are likely to be dropped."

Pennsylvania Railroad:

(See previous reports, Vol. 10, Part 1, page 509; Vol. 11, Part 2, page 891; Vol. 12, Part 1, page 378.)

Your committee inspected the "Snyder" ties installed at Derry on September 6, 1911. As will be seen from previous reports, 1,600 of these ties were put in during the summer of 1907 in Conemaugh yard and 966 in Derry yard, both on the Pittsburgh division. In these locations they are used for heavy but slow traffic. This tie consists of a steel shell 3/16-in. thick, the ties are 8 ft. long, 7 in. wide, 7 in. deep, and open on the bottom. The interior of the shell is filled with a mixture of asphalt and crushed stone, the rails are fastened to the tie by bolts and clips, and these ties weigh 700 lbs. Our inspection developed that the metal of the tie is in good condition, showing very little if any loss from corrosion, that the fastenings were holding well, but that on about 20 ties the mastic was disintegrating so that it was falling out of the ends of the ties.

Your committee also examined an experimental tie owned by Mechling and Tiechart, Munhall, Pa., of which the Pennsylvania Railroad has installed 100 near Wilkinsburg, Pa., on the Pittsburgh division.

These ties are installed in a yard track (not insulated) over which there is a heavy but slow movement. Your committee thinks this tie is capable of further development.

Your committee is advised that this company is about to install six sets of steel switch ties manufactured by the Carnegie Steel Company. The section of tie used is the modified "T" beam known as Section M-21 and weighs 19.7 lbs. per ft. The rail is fastened to the tie with a bolt and clip.

Pennsylvania Lines, Northwest System:

(For previous reports see Vol. 10, Part 1, page 505, page 513; Vol. 11, Part 2, page 892; Vol. 12, Part 1, page 383.)

Your committee examined the following ties in this company's tracks:

Rohm Steel Tie: Twelve of these ties were placed in the eastbound main freight track at Sewickley, Pa., June, 1910. They are still in the track and are giving satisfactory service. The only trouble these ties have caused has been with the insulation, which Mr. A. A. Wirth, Division Engineer, pointed out could be taken care of by a slight change in design. This tie weighs about 260 lbs.

Universal Steel Tie: Ninety-eight of these ties were installed in the eastbound main freight track near Emsworth, Pa., in June, 1911. The supervisor in charge of this track pointed out that these ties would be very hard to line on account of the projection of a portion of the fastening below the bottom of the tie. He also stated that it was very hard to hold this track in surface.

Reigler Combined Steel and Concrete Tie: Details of this tie will be found in Vol. 11, Part 2, page 893. Fifteen of these ties were put in the westbound main passenger track near Emsworth, Pa., May, 1908. They are still in the track and with the exception of three ties are in good condition. The three ties referred to show signs of failure under the rail, but the inventor thinks that repairs can be readily made so that the ties will be restored to their original condition. One other feature noticed by the committee was that several of the nuts were loose and that same could not be tightened unless ties are taken out of the track. This could be taken care of if the shape of the bolt were such that it would not turn in the hole through the concrete.

Pittsburg & Lake Erie Railroad:

(For previous reports see Vol. 10, Part 1, page 503; Vol. 11, Part 2, page 883; Vol. 12, Part I, page 375.)

Your committee inspected the experimental ties on this road in September, 1911, and as a result of this inspection would advise as follows:

Carnegie Steel Ties with Wedge Fastening: The six ties placed in the northbound main track at Pittsburg Terminal Station, May, 1908, are still in the track. The fastenings on these ties were for 90-lb. A. S. C. E. rail, and during the past year 100-lb. A. R. A. section B rail has been laid at this point, without any change in fastening. The supervisor informed the committee that they have trouble in keeping the wedges tight with the new section of rail, and previous report (Vol. 12, Part 1, page 375) states that this same trouble was experienced with the 90-lb. rail.

With Bolt and Clip Fastening: As previously reported, 3,000 ties of this design were laid in August, 1907, at McKees Rocks. Last year's report indicated that the fiber installation on these ties was approaching the end of its life, yet the supervisor in charge of this section informed your committee that they had experienced no trouble from this cause as yet. Your committee could see, of course, that the fiber is deteriorating, but they think that in view of the fact that the fiber is placed directly under the rail and not protected as the later design of this tie is now furnished (Vol. 12, Part 1, page 734) excellent results have been obtained from this fiber.

Universal Metal Tie: One hundred of these ties were installed in northbound main track Pittsburg Terminal, February, 1911. No joint ties were placed. The ties have not been in long enough for your committee to draw any conclusions therefrom.

Atwood Concrete Steel Tie: Five ties of this design were placed

in No. 4 main track, McKees Rocks, Pa., in October, 1908. Your committee found these ties in good condition; track was in good line and surface and the supervisor advised that they had had no trouble with the insulation. (See Vol. 12, Part 1, page 379, for design of this tie.)

Bruckner Reinforced Concrete Tie: Your committee was shown 20 of these ties which had not been installed at the time of our inspection. Photographs of these ties were furnished, however, by Mr. Edwin F. Wendt, assistant engineer.

One tie weighed showed a total weight of 345 lbs., while the steel plates, fastenings, etc., weighed 25 lbs.

International Steel Tie: The International Steel Tie Co., Cleveland, O., advise that they have installed 24 of these ties on this road near Glassport, Pa.

In addition to the above, Mr. Edwin F. Wendt, assistant engineer, has kindly furnished the committee with the following information in regard to cost of maintaining Carnegie steel ties mentioned above and which were installed August, 1907 (bolt and clip fastenings), as compared with a like stretch of wood ties:

Calendar Year.	Length of Experimental Track Section.	Carnegie Steel Ties. Cost of Labor.	White Oak Ties, Cost of Laor.
1908	4,400 ft.	$280.00	$$417.00
1909	4,400 ft.	153.00	95.00
1910	4,400 ft.	428.00	128.00
1911	4,400 ft.	184.00	116.00

These experimental sections of track were built with new material and new limestone ballast in 1907. The maintenance record begins with the calendar year 1908.

These ties were laid in the main line freight tracks, equipped with electric circuits in connection with automatic semaphore signals. Tracks are used by freight trains only, which run at a speed of about thirty (30) miles per hour.

During 1911 it was necessary to resurface the steel tie track three times and the white oak track once.

During the year 1911 fiber plates were removed from track on account of being cut by rail base. Twenty bolts in steel tie clips were found to be loose.

It is now January 1, 1912, 52 months since these steel cross-ties where laid in the track, and the record of the insulations shows that no fibers were renewed previous to 1911, and in that year only 17 were found defective. There has been, practically speaking, no signal trouble whatever.

Waterproofing of Masonry.

Chicago, Burlington & Quincy.

In 1909 or 1910 we furnished the Committee with some discussion on the subject of waterproofing. We have some of this waterproofing in service for about three years, and where it was properly put on, it is in good shape.

It will be noted at the right hand end of the blueprint enclosed the old method is shown. Here the waterproofing passes down over a steep slope. In some cases the pressure from the ties has forced it down the slope, tearing it apart. In order to avoid this trouble, the new method shown at the left hand end of the blueprint was adopted. The slope was made flat and the burlap was laid over a long piece of gas-pipe, placed at the top of the slope and withdrawn as the work proceeded, leaving something in the way of an expansion joint.

This has been quite successful, but if we have more of this kind of work to do, we shall make the subway slabs the same thickness as the roadway slabs, thus getting a uniform slope from the center of the street to the back of the abutment.

We are now engaged in repairing some of this waterproofing where leaks have occurred. The work was done in frosty weather and we find that the first ply of burlap was not saturated at all; the second ply begins to be saturated; the third one a little more and the fourth and fifth ones are well saturated.

On all of this cold weather work so far examined, the mastic protection over the burlap is cracked badly and the burlap at the bottom of these cracks has rotted. For purposes of comparison with this work, we have cut out a few pieces of waterproofing from portions of the structure put in the same year, but where the work was done in warm weather; here the waterproofing is in perfect condition. We attribute the cause of the trouble entirely to the fact that the waterproofing was laid in cold weather when the concrete surface upon which it was laid was cold, and the asphalt chilled before it had an opportunity to saturate the burlap.

The original cost of this work was 13-3/10 cents per sq. ft. 9-3/10 cents being for material and 4 cents for labor. (For former information, see Proceedings, Vol. II, Part 2, pp. 991-992.)

Norfolk & Western.

Subway for use of passengers under tracks at Petersburg, Va. Constructed of concrete, a 6-in. layer of concrete is placed on the area of foundation, upon this concrete against the outer forms 4-in. brick walls are built, and on the concrete base and against the brick walls the waterproofing, consisting of a coat of Sarco concrete primer applied hot, a heavy swabbing of Sarco No. 6 waterproofing and 3-ply membrane No. 16 Sarco Asphalt felt; the felt is lapped so that there is at no point less than three thicknesses of felt, each thickness being heavily swabbed with hot Sarco No. 6 waterproofing before succeeding thickness is applied.

The membrane is well swabbed with Sarco No. 6 and while this coat is still hot a layer of 8 oz. burlap is applied, this layer is also swabbed with No. 6 Sarco and a second layer of 8 oz. burlap, breaking joints with the first, is laid.

The last layer of burlap when dry is swabbed with hot Sarco.

The concrete walls, floor and steps of the subway are then built against the waterproofing above described.

The concrete subway roof reinforced with steel rails and expanded metal, laid with a crown of 1 in. for drainage is waterproofed by a mat of 2-ply burlap and 3-ply felt laid as described for sidewalls, except that the burlap is laid first or on the bottom of the mat. The roof waterproofing is protected from cutting by the ballast by a layer of 1¼ in. of Sarco Asphalt Mastic applied in two coats of ⅝-in. each, with lapped joints.

This work was done about a year ago and has proven satisfactory. Cost of waterproofing complete about 50 cents per sq. ft.

Pittsburg & Lake Erie.

Reports waterproofing on five 40 to 50 ft. four-track half deck and through girder bridges. Floor stringers spaced 15 in. center to center. Space between floor stringers filled with concrete.

Waterproofed to protect the metal work and also against dripping to the street under bridge.

Waterproofing consisted of Sarco No. 6 waterproofing with 8 oz. open mesh burlap; 1¾ lbs. of 1:2 cement mortar protection over waterproofing.

On the clean dry surface of concrete floor was applied a coating of Sarco Concrete Primer thin enough to penetrate the recesses of the concrete. Primer in some cases being too heavy was thinned with gasoline. After the primer dried (requiring about one hour) a heavy coating of hot Sarco No. 6 Waterproofing was applied and while the material was still hot a layer of 8 oz. open mesh burlap was laid.

To apply the burlap on the hot Sarco, first have it rolled on a 2-in. round stick and start unrolling immediately after applying the Sarco, exercising care to keep it straight and free from folds. Follow closely the unrolling of burlap by brooming with a rattan broom. This method was followed until three layers of burlap was applied.

On top of the last layer of burlap a heavy coating of hot Sarco was applied. As soon as convenient, after the Sarco waterproofing was applied, a 1¾-in. thickness of 1:2 cement mortar was laid.

Cost of labor $0.026 per sq. ft. treated and $0.044 for material, making a total of $0.070 per sq. ft. treated for 3 bridges on which complete data were kept. Results obtained were reported in paragraph 7, Bulletin 130, Masonry Committee reports on "Waterproofing." Last examination made September 25, 1911.

For the Sharon Road Bridge and Lion Lane Bridge: No leaks in concrete roof apparent. A few rivets in the girders show that at some time water must have passed through waterproofing.

Leopard Lane Bridge: Under No. 1 track water is dropping slowly at three places. At six other places indications point that water has been dropping at some time and at a few other places in girders indications are that water has passed through rivet holes at some time.

Third Street Bridge: No. 1 track, no leaks. No. 2 track, five places at edges of floor-beams indicate that water has come through and at two of these places it was dropping slowly at last inspection. Track No. 3, two places water dropping. Track No. 4, no leaks.

Second Street Bridge: A good many leaks show at this bridge. This is the bridge on which an unfavorable report was made before and there is no indication of any decided change. Leaks show at edges of floorbeams and girders. Water is slowly dropping through at many of the rivets.

The reason advanced for the unfavorable condition of waterproofing on these bridges is that the concrete was not allowed to set up naturally, artificial heat having been applied to dry it preliminary to applying the Sarco Primer, and in some cases the waterproofing was applied in unfavorable weather conditions.

Have just completed bridge at Aliquippa, which was waterproofed in the same manner as those above described but with all conditions favorable for a fair test, such as dry concrete on which to apply the first coat (Primer) and dry and warm weather during the time the waterproofing was applied. It will be interesting to observe the results in connection with this structure which is known as the Third Street Subway at Aliquippa.

Another reason advanced for the failure of the waterproofing

outlined in the first paragraph is that the cement mortar cover may be broken under impact of traffic and the ballast may have cut the waterproofing.

Third Street Subway, Aliquippa, Pa.: This is a ballast bridge, 288 ft. wide, and supporting about 20 tracks. The distance between abutments is 40 ft. and a line of columns supports the floor structure at the center.

The floor is made of 15-in. 80-lb. I-beams, 44 ft. long, spaced 15 in. c. to c. and filled between with 1:3:5 concrete.

The structure is waterproofed with Sarco No. 6 waterproofing, with 2-ply, of 8-oz. open mesh burlap, using same method given in answer to question No. 4 of Circular dated September 16, 1911, except that two layers of burlap were used.

The area covered was 14,000 sq. ft.

Sarco Primer, 151 gals. @ $80.35 per gal.....	$ 52.85
Sarco No. 6, 16,200 lbs. @ $35.60 per ton....	288.36
Burlap, 1,560 lbs. @ $0.08 per lb.....	124.80
Total cost of material.....	$466.01
Total cost of labor.....	251.38
Total cost of labor and material.....	$717.39

Material cost $0.033 per sq. ft.

Labor cost $0.018 per sq. ft.

The waterproofing was protected by 1¾-in. cement covering made of 1:2 mortar. The area covered 13,320 sq. ft.

Sand used, 52 tons @ $0.65.....	$ 33.80
Cement, 131 bbls. @ $0.85.....	111.35
Labor	103.00
Total	$248.15

Material cost $0.011 per sq. ft.

Labor cost $0.008 per sq. ft.

The waterproofing was applied at different times between May and August, 1911, under favorable weather conditions and is in good condition at this date, October 5, 1911.

Canadian Pacific.

(Waterproofing Subways.)

McPhillips Street Subway: Deck of subway of steel plate. Waterproofing used dry felt, tarred felt, burlap and Gilsomite asphalt, applied as follows:

On the steel deck is laid a layer of dry felt, then a layer of tarred felt with asphaltum, over this is laid two layers of burlap each mopped with asphaltum, then a layer of tarred felt mopped with asphalt, over this is laid a layer of tarred felt not mopped and last a layer of dry felt. The cost of this waterproofing was 12½ cents per sq. ft. The work was completed in 1911 and at last inspection during October, 1911, was found satisfactory. Two small leaks appeared along joint made with previously constructed waterproofing. Waterproofing is protected by a coat of tar concrete 4 in. thick. The cost of this protection is 9 cents per sq. ft.; this is not included in the above price for waterproofing.

The work covers 10,500 sq. ft. Expansion is taken care of by the layers of dry felt.

Rachael Street Subway: Reinforced concrete deck waterproofed by burlap and pitch, using five layers of burlap and pitch between each layer. The work was completed in 1908 and is fairly satisfactory. On last examination in October, 1911, a few small leaks showed. No protection to waterproofing was used. The ballast was laid directly on top of the waterproofing.

Weston Shops (Winnipeg): Deck of subway old rails encased in concrete. Waterproofing material, burlap and asphaltum.

The concrete was first covered with a layer of asphaltum on which is laid one thickness of burlap, then a layer of asphaltum, then another thickness of burlap and then a good covering of asphaltum over all. The total cost of this waterproofing is 8½ cents per sq. ft. The work was done in November, 1910, and results obtained are satisfactory; last examination in October, 1911, showed no leaks. No protection was used over the waterproofing. Gravel was laid directly on the waterproofing.

Union Station (Regina): Conditions requiring waterproofing; surface water and leakage from tank and pipes leading from dam to roundhouse, gardens and various buildings. Materials used were cement mortar and pitch. The waterproofing was applied as a plaster against the wall and afterwards given a good coating of pitch. The cost of the waterproofing labor was 1.93 cents; the cost of waterproofing material was 2.72 cents; total cost of waterproofing per square foot of surface treated was 4.88 cents, this includes superintendence. Work was completed in August, 1911, and from an inspection made during October, 1911, the results obtained are apparently remarkably good. No protection was used. Back filling was placed directly against waterproofing.

Union and Southern Pacific Systems.

Brick Depot Building: Coating brick walls on interior with asphaltum paint, before applying plaster; the paint used was Toch Brothers B. I. W., applied with spraying machine or three-coat work with brush. The cost of the work was 11 to 13 cents per sq. yd. applied with spraying machine. The work was done in 1907 and at last inspection, September 30, 1911, the plaster was found to be dry and decorating in good condition.

Hospital Building Basement: Used 5 per cent. Medusa compound, first mixed dry with cement, then added to other aggregate, proportion one part cement, one part sand and five parts stone, size of stone ¾-in. to 1¼ in. The mixture was so-called wet mixture (water appearing freely on surface). The work was done in 1909 and upon last inspection, September 28, 1911, the walls and floor were dry, no leaks and no moisture appearing. The cost of the work account waterproofing was increased $1.10 per cubic yard.

Oregon-Washington Railroad & Navigation Co.: Waterproofing concrete wall, built 1:3:5 mixture, blue cross cement, ordinary run of gravel and sand, maximum size of gravel passed 2-in. ring. Head of water 6 ft. Waterproofing consisted of Wunner's Bitumen Emulsion, mixed 2½ pints of this material with one bag of cement and 2½ cu. ft. of sand, adding water to plaster consistency applied to surface of wall; the work was done September 1, 1911, and at last inspection, October 28, 1911, showed small amount of surface water but no apparent leaks.

The cost was about 10 cents per sq. ft. of surface waterproofed.

Methods of Patching and Repairing Plain and Reinforced Concrete.

A circular letter, under date of July 14, 1911, was sent to members of the Association, requesting information on this subject, to which letter more than one hundred replies have been received. Nearly all of the replies contain useful information, but as the some methods are frequently described by several writers, a selection has been made from these replies and presented as an appendix.

(1) Wet Method: The surface of the old concrete is thoroughly roughened, cleaned and drenched with water and covered with a cement grout. Then the new concrete is mixed to a sloppy consistency and applied, being held in place till set by forms, as required.

Comment: From the reports received it appears that many successes and many failures have followed this method. Where it has been successful, that result probably has been due to painstaking care and expense being employed in the preliminary cleaning and thorough wetting of the old concrete surfaces before the new concrete is applied.

(2) Moderately Dry Method: The surface of the old concrete is thoroughly roughened, cleaned and drenched with water and powdered with cement or painted with cement grout—after which the new concrete is applied and thoroughly tamped against the old surface. Generally, such patches are kept moist by sprinkling them with water for several days.

Comment: The same comment applies here as to the wet method.

(3) Dowel Method: This is a modification of the two preceding methods and is generally used for other than horizontal surfaces, although it may be applied to the latter. The new concrete may have any consistency to meet the particular conditions or the ideas of the Engineer in charge, but usually a fairly wet concrete is used. This method includes drilling holes and setting dowels into the old concrete with projecting ends to engage into the new concrete. Sometimes steel bars or metal fabric are connected to these dowels to further insure permanency of the patch.

Comment: This method can be made uniformly successful, but cannot always be applied. Where any considerable mass of new concrete is to be connected to old concrete this is the only safe method to pursue.

(4) Wedge Method: This method includes the cutting out of defective concrete in such a manner as to undercut the surrounding good concrete so that the new concrete will be held in place, when set, by the shape of the binding edges of the old concrete.

Comment: The difficulty of undercutting concrete so as to secure such edges is too great to make this method applicable in ordinary cases, and, except where a considerable depth of new concrete is to be put in, such undercutting could not be successfully done, as concrete cannot be cut so as to leave sharp, clean edges.

(5) Cleaning with Steam: This is a method of cleaning surfaces of old concrete preparatory to putting on a patch of new, or of cleaning the top of a rough concrete floor before applying the "finish coat." The surface of the old concrete is brushed as clean as possible with stiff brushes and then gone over at least twice with a steam jet—an ordinary piece of half-inch gas pipe makes a very satisfactory jet nozzle. This short length of pipe is connected to a steam hose so that it can be readily moved about. The steam will clean and heat the concrete surface, leaving it perfectly dry, so it is important to thoroughly drench the surface with water after cleaning with steam. In cold weather

it is found advantageous to use hot water. Immediately after the surface is thoroughly cleaned and drenched, the new concrete is applied.

Comment: Excellent results have followed the use of this method of cleaning, but it is essential that the surface of the old concrete be thoroughly drenched with water after using the steam jet, otherwise the new concrete will not adhere to the old.

(6) Cleaning with Acid: This method includes washing of the surface of the old concrete, with a solution of hydrochloric (muriatic) acid (one part acid to two parts water), after which the surface must be carefully and thoroughly washed to remove any free acid.

Comment: This is a very commonly applied method of cleaning old concrete surfaces preparatory to placing new concrete against them, and, by many, is considered the only safe one to use, especially where a "finish coat" is to be put on after the concrete base is set.

Conclusions.

Your committee presents the following conclusions as to the methods of repairing defective or worn surfaces of concrete:

(1) In all cases the surface to be repaired must first be thoroughly cleaned of all loose material, laitance and dust and the clean, rough, sound concrete exposed to receive the patch. Probably the best method of cleaning is by means of a steam jet.

(2) After cleaning, the surface to be repaired must be thoroughly saturated with water, not simply moistened, but so thoroughly drenched that the old concrete will not absorb water from the new mortar or concrete used in patching. If possible, the surface should be kept covered with water for several hours.

(3) If the repair or patch is to be made on a vertical or sloping surface and is not to be more than 1½ in. thick, the surface of the old concrete, while it is still wet, should be spattered or splashed with a cement grout, following this immediately with a fairly stiff plaster coat of mortar made of the same proportions of cement and sand as was used in the original concrete, but never richer than 1 cement to 2½ sand. This plaster coat should not be thicker than ½-in. and each coat should be forced into the surface, but not dragged with a trowel. The surface of each coat, except the final coat, should be "scratched" to give a bond for the next coat. This plastering should preferably begin at the top and progress downward, and only enough time be allowed to permit each coat to receive its initial set before the next coat is applied. The final coat should be finished with a wooden float and only enough water used to properly finish the surface. This patch should be kept damp and protected from sun or frost till fully set up.

(4) If the repair or patch or "finish coat" is to be made on a horizontal or nearly horizontal surface, the surface of the old concrete should be slushed and broomed with a thin cement grout, following this immediately with a wet mortar made of 1 part cement and 2½ parts sand or granite screenings and of the full thickness required (not less than ½-in. thick, however). When this mortar begins to take its initial set, it should be floated or troweled to such a finish as may be desired.

(5) If the repair or patch is to be made on a vertical or sloping face and is to be more than 1½ in. thick, it will be advisable to embed dowels into the old concrete, as deeply as the thickness of the proposed patch, and spaced sufficiently close together to firmly anchor the patch to the old concrete. The dowels must be wedged into the old concrete and it will be advisable to fasten wires, metal fabric or bars to the dowels, in the case of extensive patching, as an additional safeguard. The patching may then be done with mortar without forms, or with wet concrete supported by forms, depending upon the thickness and the extent of the patch.

(6) If the repair or patch is to be made on a horizontal or nearly horizontal face and of considerable thickness, dowels may be used, or the concrete may simply be reinforced by fabric or bars without using dowels—treating the patch as a block of masonry.

(7) Care must be taken not to have thin edges on patches. To avoid this, it may be necessary to cut out sound concrete around a place to be patched, so as to give deep edges to the patch. If possible, the edges should be undercut.

Conservation of Natural Resources.

*Advantages of Oil as Fuel Compared to Coal.

The principal advantages incident to burning oil as compared with coal can be summed up as follows:

(1) Cost. This item depends entirely on relative price at mine and well, plus freight to point of consumption. In computing freight haul, tariff rates must govern when moved over foreign lines the actual cost of moving (not including what is known as fixed charges) ordinarily used in computing cost over home rails. In making these computations the fact that from 1,000 to 1,500 lbs. of oil equal 2,000 lbs. of coal must be taken into account.

(2) Decreased cost of handling oil from cars to engines with practically no loss by depreciation due to such handling, all coal suffering badly in passage through coaling plants of whatever type.

(3) The losses by evaporation suffered by coal do not apply to oil, neither does loss by theft in transit occur, oil reaching engine tenders unimpaired as to quality and undiminished in quantity.

(4) Saving of time at terminals and increased mileage per engine, it being unnecessary to cut engines out for flue cleaning; the oil capacity of tender approximating 150 per cent of that of coal, making longer runs possible.

(5) Freedom from physical failure of firemen in extreme hot weather, the fireman's work being actually lighter than that of the engineer.

(6) Stability of delivery, oil being unaffected by labor conditions which has made the production of coal in some sections so uncertain as to necessitate the storage of immense quantities of coal at great expense, this condition occurring at frequent intervals.

(7) Greater cleanliness in handling passenger trains with almost absolute immunity from right-of-way fires, saving the cost of fire-guards, and reducing also claim department losses.

The drawbacks to the use of oil have been in the direction of uncertain supply. The expense of equipping the average locomotive to burn oil approximates $800; the cost of constructing steel storage tanks of large capacity approximating 25c per barrel. The necessary terminal facilities, however, cost but about 50 per cent of the amount required to handle coal. With coaling facilities usually in place, however, the oil facilities, when installed, represent a duplication. Frequently, before the producer is able to judge his production sufficiently well to warrant the making of definite contracts, large quantities of "pot" oil must be sacrificed for want of storage or market facilities. After the production is reasonably well determined, an interval of time is necessary to transform locomotives, these factors being embarrassing both to the oil producer and the railroad consumer. With the development of new fields and the purchase of large numbers of cars, together with the increased installation of oil-burning apparatus, this condition will grow less burdensome in the future than it has been in the past.

The relative cost of oil and coal as a locomotive fuel is governed entirely by local conditions. Any road contemplating the use of oil must test the grade of oil or residuum it expects to burn against the grade of coal for which it is to be substituted. Different coals grade within greater extremes than do oils, which fact, if proper allowance is made for water and sediment in the case of crude oil purchases, will show a limited variation in the number of British thermal units per pound of fuel.

Government Fuel Oil Specifications.

In consequence of the success that has attended the use of heating-value specifications in buying and selling coal, there has arisen a demand for similar specifications, based on careful tests, to govern the purchase of fuel oils and the refined products of petroleum. The bureau of mines has therefore issued technical paper No. 3, by Mr. Irving C. Allen, on "Specifications for the purchase of fuel oil for the Government," with directions for sampling oil and natural gas.

The general specifications for the purchase of fuel oil are given as follows:

In determining the award of a contract, consideration will be given to the quality of the fuel offered by the bidders, as well as the price, and should it appear to be to the best interest of the government to award a contract at a higher price than that named in the lowest bid or bids received, the contract will be so awarded.

Fuel oil should be either a natural homogeneous oil or a homogeneous residue from a natural oil; if the latter, all constituents having a low flash point should have been removed by distillation; it should not be composed of a light oil and a heavy residue mixed in such proportions as to give the density desired.

It should not have been distilled at a temperature high enough to burn it, nor at a temperature so high that flecks of carbonaceous matter began to separate.

It should not flash below 60 degrees Centrigrade (140 degrees Fahrenheit) in a closed Abel-Pensky or Pensky-Martens tester.

Its specific gravity should range from 0.85 to 0.96 at 15 degrees Centigrade (59 degrees Fahrenheit); the oil should be rejected if its specific gravity is above 0.97 at that temperature.

It should be mobile, free from solid or semi-solid bodies, and should flow readily, at ordinary atmospheric temperatures and under a head of 1 foot of oil, through a 4-in. pipe 10 ft. in length.

*From address by Mr. Eugene McAuliffe before International Railway Fuel Association.

It should not congeal nor become too sluggist to flow at 0 degrees Centigrade (32 degrees Fahrenheit).

It should have a calorific value of not less than 10,000 calories per gram (18,000 B. T. U. per lb.), 10,250 calories to be the standard. A bonus is to be paid or a penalty deducted according to the method stated under section 21, as the fuel oil delivered is above or below this standard.

It should be rejected if it contains more than two per cent water.

It should be rejected if it contains more than one per cent sulphur.

It should not contain more than a trace of said clay or dirt.

Each bidder must submit an accurate statement regarding the fuel oil he proposes to furnish. This statement should show: The commercial name of the oil; the name or designation of the field from which the oil is obtained; whether the oil is a crude oil, a refinery residue or a distillate; the name and location of the refinery, if the oil has been refined at all.

The fuel oil is to be delivered f. o. b. cars or vessel, according to the manner of shipment, at such places, at such times, and in such quantities as may be required, during the fiscal year.

Should the contractor, for any reason, fail to comply with a written order to make delivery, the government is to be at liberty to buy oil in the open market and charge against the contractor any excess of price, above the contract price, of the fuel oil so purchased.

Complete copies of these specifications may be obtained from the director of the bureau of mines, Washington, D. C.

Tree Planting and Reforestation in Canada.

The Forestry Branch of the Department of the Interior (Government of Canada) has, since 1900, been carrying out a scheme of free tree distribution to farmers in the prairie provinces of Manitoba, Saskatchewan and Alberta. During that time some eighteen million trees have been sent out from the nurseries of this particular branch. The trees are planted on the homestead throughout these provinces for windbreaks, shelter belts and wood supply. Nurseries have been established also on some of the forest reserves, and some planting is being done.

In 1894, the Government of the Province of Ontario established a nursery at the Ontario Agricultural College, Guelph, Ont., and they have since been distributing trees to farmers throughout that province. This nursery has since been removed to St. Williams, Ont., where the Provincial Department of Agriculture has acquired some 1,300 acres of sandy land, which it is planting up with forest trees. The Province of Quebec has also established a forest nursery at Berthier, P. Q., but the distribution from there has, as yet, been small. In a few instances, planting or sowing has been undertaken in other provinces of the Dominion by individuals or private concerns.

The Canadian Pacific Railway Company has also taken in hand the planting of trees of different varieties on the prairies. The trees and shrubs used are Russian Poplar and Willows, Box Elder, Ash, Spruce, Scotch Pine, Caragana and Artemosia. A good deal of this work is done along the cuts, in order that the trees and shrubs may serve as permanent snow fences.

There is also a permanent plantation at Wolseley, Sask., to determine the values of different species of trees for tie purposes, as well as for the correct spacing and mixture. The species selected are native tamarack, Scotch, red and jack pine, and although the plantation has not been established long enough to give any reliable figures as to growth, the results so far have been satisfactory. This plantation is situated on dry upland prairie. The tamaracks, or larch, used were transferred from swamp land to the plantation, and the growth on the high land, so far, has been three times faster than at any time in the swamp. It is hoped that this plantation will ultimately afford reliable information as to the selecting and planting of such trees as will eventually be suitable for tie timber.

Investigations are also being made by the Canadian Pacific Railway Company as to the value of cut-over and virgin timber lands in selected locations, in order to determine the value of these lands for permanent tie reserves. The information obtained from this source is not, as yet, sufficient to give out anything of a definite nature, but it will be continued, and in a few years it is also hoped that reliable information will be obtained regarding this reforestation.

The consumption of timber in the year 1910 was as follows:

Lumber	4,901,649,000 ft. B. M.
Square timber	37,962 tons
Shingles	1,976,400,000
Lath	851,953,000
Pulpwood	598,487 cords
Poles	782,841
Cross-ties	9,213,962
Mining timber (round)	52,848,000 linear ft.
Mining timber (sawn)	22,305,000 ft. B. M.
Cooperage (slack), including staves, heading and hoops	161,641,000 pieces
Cooperage (tight)	8,370,000 pieces

Annual Fire Loss.

The information in regard to the annual fire loss is not definite, as much of the loss occurs in districts so far removed from settlement that it is impossible to make any reliable estimate. The annual loss from forest fires will, however, run between 250,000,000 and 500,000,000 ft., board measure, per annum. In very wet years it might fall below the minimum—in very dry years it will go over it. The value of the timber destroyed might be taken at one dollar per thousand at the stump. In the districts where railways are being constructed, they are the most frequent cause of fire—at least 50 per cent of the fires being caused by them. In the districts beyond where the railways are constructed, fires are mostly due to the clearing of the land by settlers.

Coal and Fuel Oil Resources.

In the Dominion the aggregate area of coal lands is 29,957 square miles, containing about 172,100,000,000 tons of the several classes.

Little, as yet, has been done towards ascertaining the loss incident upon coal mining operations in Canada. Nova Scotia has recently taken steps to secure this information by issuing coal depletion statement forms to be filled in by the mine operators. It has been stated by some authorities that for every ton of coal mined, one-half a ton is lost or wasted; and in thick beds the recovery probably does not exceed 30 per cent.

The wastes attending coal mining operations may be enumerated as follows:

(1) Coal lost beyond recovery by mining lowest seams first.
(2) Coal left in pillars to support the roof.
(3) The low grade coal left in the mines.
(4) Slack coal formed during mining operations.

In Western Canada where there are so many seams of great thickness close together, it is looked upon as important that the upper seams should be mined first, so that any caving as a result of removing the pillars will not render it impossible to get at the other seams.

Great losses have resulted also from improperly burned coal. The loss in smoke alone with bituminous coal has been estimated at about 10 per cent.

Peat Deposits in Canada.

In round numbers there are 37,000 square miles of peat lands scattered throughout the various provinces.

As a result of investigations carried on in Canada it has been demonstrated that:

(1) For the economic production of fuel from peat, machinery driven by power must be substituted as far as possible for manual labor.

(2) That processes so far invented for removing the water content of the peat by pressure or artificial heat have not hitherto led to profitable commercial results.

A number of bogs, however, are being exploited to some extent, and the result of the operation of one of them in particular, viz., the plant at Alfred, Ont., goes to prove that the production of excellent peat fuel is a commercial possibility.

It has been found that one ton of peat burned under boilers is equal to about 5/9 of a ton of coal. It does not clinker, nor give off any objectionable volatile matter in the form of black smoke, and as a domestic fuel, it is clean, easily handled and efficient.

Crude Petroleum.

The waste which occurs in oil production in Canada is not so much in the oil itself as in the natural gas incident to the oil production. The oil when obtained, may be sold at once, whereas to sell the gas, long expensive pipe lines must be laid, franchises obtained from towns or cities and their market is but limited.

Natural Gas in Canada.

The production of natural gas in Canada has increased in value nearly ten-fold during the last eighteen years, and of the total amount the Province of Ontario produced about 95 per cent.

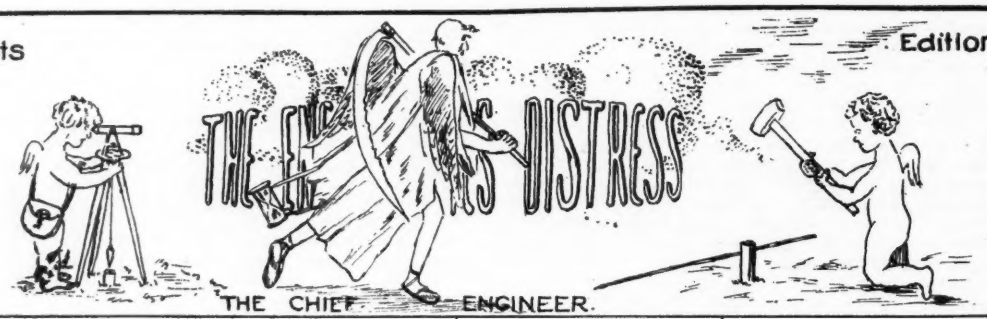
Steps were taken by the Ontario Government in 1907 to prevent the waste of natural gas, and a law was passed levying a tax of two cents per 1,000 ft. with a rebate of 90 per cent when the gas is used in Canada. This provision has been very effective.

In Alberta little provision has as yet been made for the plugging of the gas wells, and many millions of cubic feet have therefore been wasted annually and extended areas have been more or less drained.

In order to conserve the supply of natural gas, the gas must be utilized (1) for the purpose for which it is most valuable; (2) in the manner that will secure the greatest efficiency; and (3) as near as possible to the point of production. The most valuable uses for natural gas for domestic purposes and the development of power.

This report was presented as information.

Poets Edition.



3/14/12.

Ye Editor.-

For your waste paper basket. Auto suggestion from seeing Maude Adams. P. M. L.

Ye Editor,-

Your letter of yesterday inquiring how a member of the Engineering Dep't. ever raised the capital for a ticket to see Maude Adams, at 75 cents per foot or $1.50 per seat, is at hand.

To tell the ugly truth the desire to see an unusual variety of stage chicken artistically drawn was too much for my principles and I resorted to graft.

Now while I deny your right to exercise the inquisitorial power of a commission or committee in inquiring into the relative humidity of my capital account, yet George Washington, John O and uncle Andrew having answered voluntarily, I feel bound by their illustrious precedent and will now do so. Herewith attached, and made a part here of, Marked Exhibit "A."

P.M.L.

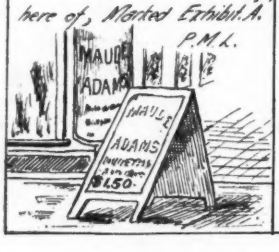


Exhibit "A"

CANTO I

Listen while I tell
A story unto you,
One that's sad as well;
And sadder for tis true.
(Here endeth the first Canto)

CANTO II.

In Technical schools the candles burned
To give us knowledge where e'er we may go,
But the most usful thing I ever learned
Was a practical way of tramping down snow.

CANTO III.

Of police we can offer a charming variety
Far renowned for learning and piety,
Still I will bet you without impropriety
Patrolman Flynn is the flower of them all

CANTO IV

Now in the play-house lobby,
Where you never find a seat,
Arthur Flynn's cousin bobby
Let us in on dear ARTS ante,
When I helped him on his beat.

CANTO V

How I helped him on his beat you want to know?
Well I walked ahead with measured tread, and slow:
Tramping down the snow,
Tramping down the snow.

CANTO VI

Too much Art and weather
Make us sing together,
As up the street we go,
A'tramping down the snow.

"O Lady, wake!-
the azure moon
Is rippling in the verdant skies,
The owl is warbling his soft tune,
Awaiting but thy snowy eyes.
The joys of future years are past,
Tomorrows hopes are fled away;
Still let us love,
and e'en at last,
We shall be happy yesterday."

The "Ginny"

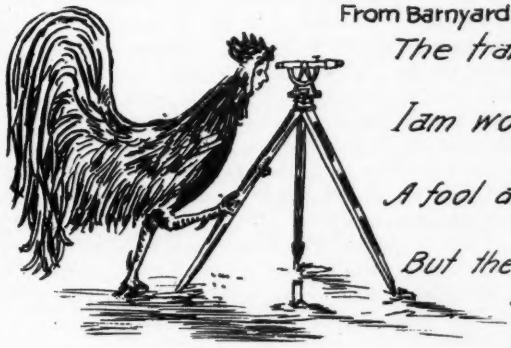
Jinglebells hes gotta the job
a nice wun too,
He work for the railroad
alla the time,
And save his money too.
He works with the
Injaneer and drive the
state so,
And then he hears
a some one say
Hurra up ginny you so slow

Wuna day the President
he come along,
He ees the bigga the man
He geer the Injaneer
wan nisa the look,
And make the chest
expan.
Nexta morn the Injaneer
say to heem
Jinglebells yous gotta go
Your muss eet get flabby
Yourir worrk ees so
much slow.
So Jinglebells he lost
hees job,
And to Sunny "It"
he went.
And now he isa the
reecha the man,
Thisa letter to me
hee sent.
Good-a-bye Joe,
I nerer a coma back
I weara now the nisa
the clothes,
And a greata big
stiffa the hat.
You saya to Mr. Injaneer
Good-a-bye for me, to heem
But if I erer coma
back
I steek a the knife
right een.

A.R.G.

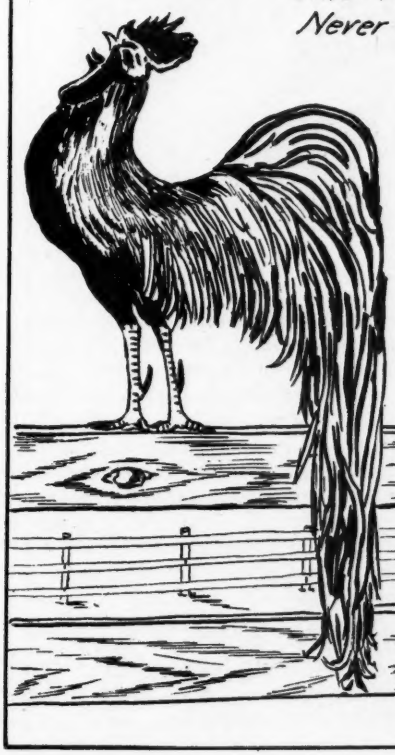
CHANTICLER (A VOL. OF ALLEGED POETRY)

From Barnyard Surveys by Roosterand.

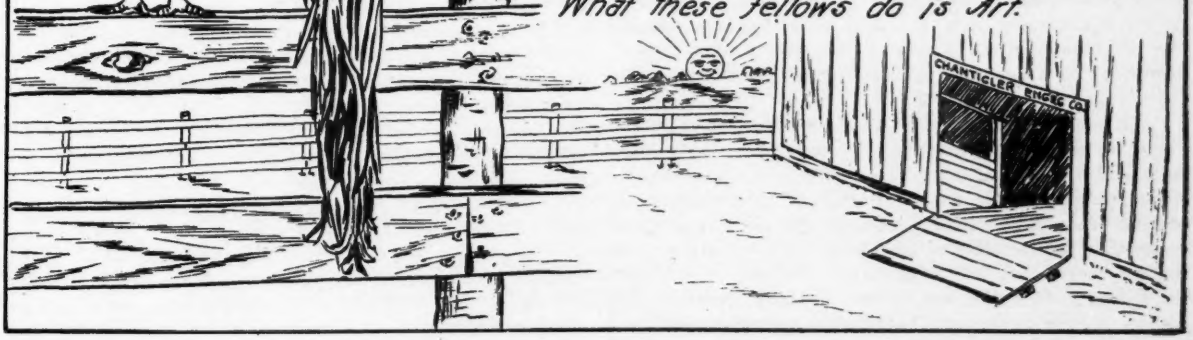


The transitman remarked to the muley cow,
As she chewed her daily hay,
I am working for pleasure, for it's funny how
My salary's spent before pay day.
A fool am I to do it, for what do I get?
My food and also my lodging. My!
But the poodle gets that - he is the household pet
And he never sold a single bark yet,
Not even when bark was high.

The levelman then remarked to the brindle hen,
As he masticated his cud.
What in — well, thunder and blitzen can you do then?
You quit and your name is mud.
I am good for twenty miles of walking per day.
I get my lodging and grub
But the parrot gets all she can gobble anyway,
And what the deuce has she to pay?
Never a new cuss-word the dub.



But just then the chief engineer said to the pair,
You get all that's coming to you.
The poodle does tricks and the parrot can swear
Which is better than you can do.
May be you are needed, but what's the use
Of bewailing your daily part?
For you are très bourgeois - works your only excuse
You can do nothing but just produce.
What these fellows do is Art.



VERTICAL LIFT BRIDGE AT KANSAS CITY, U. D. B. & T. CO.

The Fratt bridge, over the Missouri river at Kansas City, occupies the site selected for a bridge in the early eighties. At that time piers were built for a proposed high level bridge, but the structure was not completed. All of the main piers are incorporated in the present bridge, having been modified to suit the new conditions.

The bridge over the river between harbor lines consists of three double deck, riveted truss spans providing on the lower deck two standard railway tracks, and on the upper deck two street car tracks, and separate roadways and sidewalks for vehicular traffic and pedestrians.

The upper roadways are carried to the north and south of the river spans on steel viaducts supported on pedestals resting on concrete piles, the south terminus being at Third street, and the north terminus in Clay county.

To permit the passage of boats, one river span contains a lifting deck, which consists of a double track railway bridge floor, with a lateral system, supported by stiff hangers from each panel joint of the upper truss. When the deck is in its lowest position a pin in the upper end of each hanger rests in a socket in diaphragms in the post above, transmitting the live loads directly to the upper trusses. Each hanger is arranged to telescope into the truss post above and is attached to two cables which pass up and over a sheave on the top of the upper truss; thence to the end of the span and over a common drum at one corner of the span; thence downward to a counterweight. There is, thus, a separate counterweight for each hanger.

Operation is effected by rotating the four drums at the top of the span. The two drums at each end are on a single shaft which is geared down to a motor. In order to synchronize mechanically the movements of the machinery at opposite ends of the span, a double rope drive is provided connecting the two sets of machinery. The counterweights for the rope drives are arranged so that one rope is taut for driving in each direction. Under ordinary operation both motors will be in service, but, should one motor fail, the entire deck can be operated by the motor at the opposite end through this rope drive.

When the deck reaches its lowest position, locks automatically engage each hanger and the ends of the deck. All locks are withdrawn at one operation by a motor and gears in the south machinery house.

In addition to the manifest advantage of maintaining traffic on the upper deck at all times regardless of the movement of boats, this movable deck afforded large economies in construction and will afford similar economies in operation.

The lower deck accommodates two steam railroads between trusses. The upper deck carries between trusses two heavy electric railways in a paved roadway 24 ft. wide; outside the trusses are two sidewalks each 4 ft. wide and two asphalt paved roadways each 13 ft. 6 ins. wide. Pleasure automobiles are permitted to run in the street car space.

All spans are of the riveted type. The railway deck of the southern span lifts vertically, affording at high water 55 ft. vertical and 413 ft. horizontal clearance for vessels, leaving the upper deck unbroken. Deck posts telescope into the truss posts in rising. The lifting deck is fully balanced by concrete counterweights and is locked down when in service. The lifting deck weighs 1,500,000 lbs., and is raised to full height or lowered in 50 seconds by electric power.

View From Top of Lift Span, Kansas City Bridge.

The river piers were sunk by the pneumatic process to bed rock about 80 ft. below low water. The pedestals beneath the viaduct and the pier south of the railroad track on the north side of the river are carried on reinforced concrete piles.

The approaches for the upper deck consist of 3,100 ft. of steel trestle of the same width and general construction as the upper deck of the river spans and include two truss spans over railroad tracks. The approaches for the lower deck consist of a small girder span at each end of the bridge and abutments supporting the embankments. The total length of the structure is about 4,400 ft.

Superstructure Metal.

South Approach.

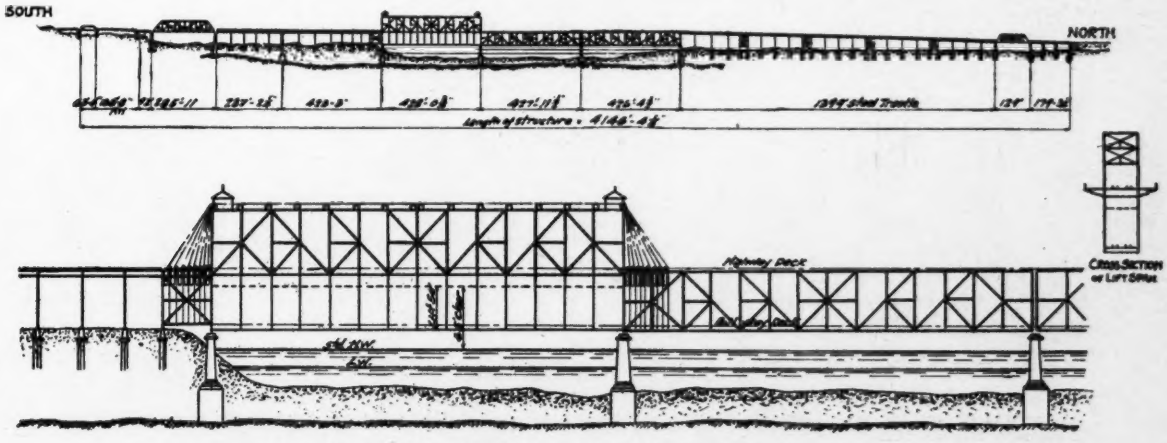
	Tons.	Tons.
Span at Second street	113	
Span over tracks	1,504	
Viaduct	885	
Total south approach		2,502

Lift Span.		
Carbon steel	4,203	
Nickel steel	346	
Machinery	292	
Total lift span		4,841
Fixed river spans, two		8,037
North Approach.		
Viaduct	2,460	
Skewed span	236	
Total north approach		2,696
Grand total		18,076

12,440 sq. yds. side roadways.

2,100 sq. yds. sidewalks.

380 cu. yds. concrete in counterweights, each about 50,000 lbs.



Vertical Lift Bridge at Kansas City, Union Depot Bridge & Terminal Co.

Area and Weight of Members.

Lift Sapn—	Size Ins.	Area Sq. In.	Length Ft.	Length Ins.	Weight Lbs.
Column supporting	72x63	517	56	1	132,000
Inclined end post	60x55	345	99	0	186,636
Bottom chord mid section	60x51	499	88	1	211,097
Top chord mid section	64x60	483	72	3	138,075
Fixed River Span—					
Bottom chord mid section	60x47	450	89	3	209,472
Top chord mid section	60x55	429	73	3	154,177
Timber piles					13,500 lin. ft.
Rolled concrete piles (Chenoweth type)					38,600 lin. ft.
Timber—Creosoted					950 M. ft. B. M.
Untreated					250 M. ft. B. M.

The trusses of three river spans were assembled near the bridge site and all field holes reamed. About 500,000 field rivets were driven. Fifty tons of paint were required for the structure. New work on substructure began August, 1909. Erection of steel began May, 1910.

The entire bridge, except the substructure and the electrical equipment, was built by the McClintic-Marshall Construction Company, of Pittsburgh, Pa. The old piers were remodeled and concrete pedestals built by James O'Connor & Son, Kansas City. The concrete piles were made and driven by the American Concrete Company, of Chicago. The electrical equipment was furnished by the American Electric Company, St. Joseph, Mo.

The Fratt bridge was designed by and constructed under the supervision of Waddell & Harrington, consulting engineers, holders of exclusive patents for lift bridges. R. S. Moore was the resident engineer on the job.

New Books

RAILWAY TRANSPORTATION. By Chas. Lee. Paper, 331 pages. Cloth, 5¼x8; published by G. P. Putnam's Sons, 2 West 46th St., New York City. Price, $1.50.

This book, in so far as it concerns the early history of railways, is based upon Hadley's "Railroad Transportation." Its chief purpose is a revision and enlargement of Prof. Hadley's book. It traces the history of railway transportation in its more vital aspects in Great Britain, France, Italy and the United States. This historical section is for the purpose of throwing light upon the present management and regulation of railways. The work is divided into seventen chapters. Chapter I is on "Modern Transportation," chapters II, III and IV deal with "Railway Transportation in Great Britain," Chapters V and VI deal with "Railway Transportation in France," Chapters VII and VIII deal with "Railway Transportation in Italy," Chapters IX and X and XI deal with "Railway Transportation in Germany," Chapters XII, XIII, XIV, XV and XVI deal with "Railway Transportation in the United States." The last chapter takes up the subject of "State Operation of Railways." In this last chapter the author covers the much discussed question of Government ownership in a most conservative manner. His position is best described in the following quoted paragraph:

"It has, we think, been made reasonably clear that private operation of railways in the United States under Government control has become comparatively efficient and equitable. It is equally clear that a government so divided and decentralized and so changeable in its partisan politics, as that of the United States, cannot efficiently manage a business involving so much capital and so much risk and complexity as railway transportation, especially when there is in reality no fundamental cause for such action."

AMERICAN WOOD PRESERVERS ASSOCIATION, PROCEEDINGS OF EIGHTH ANNUAL MEETING, 302 pages, cloth; published by the American Wood Preservers' Association, F. J. Angier, secretary, Mt. Royal Station, Baltimore, Md.

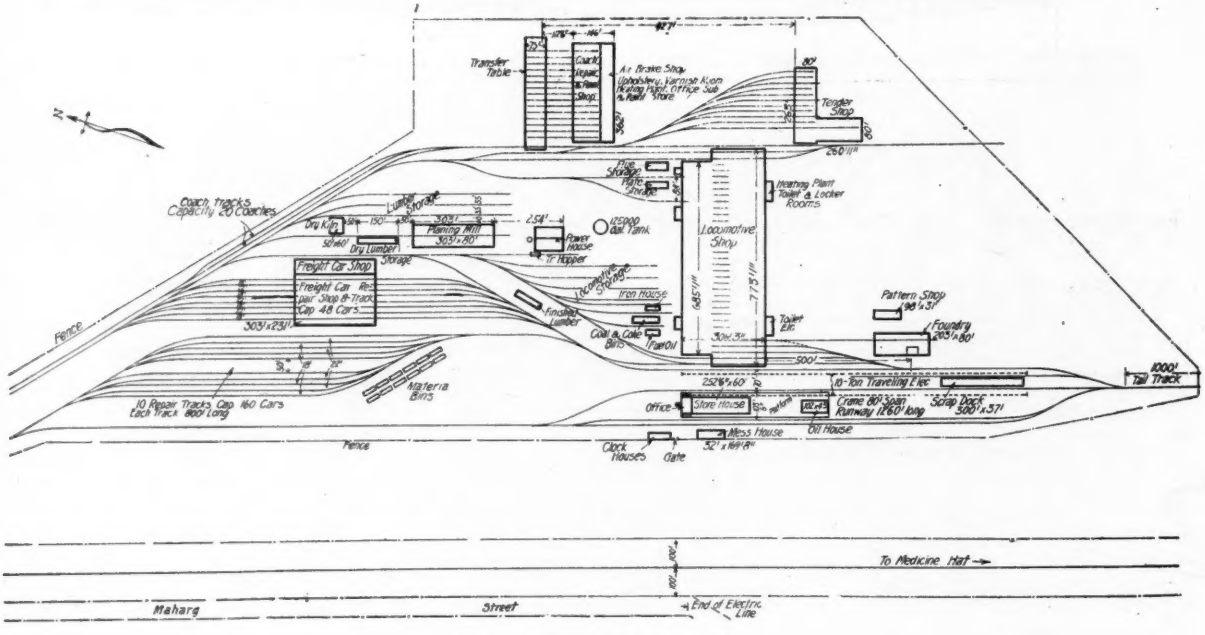
This volume contains the complete report of all papers presented at the meeting, together with the discussion of the same. The following are the subjects considered, which are of interest specially to railway men: The Production of the Wooden Cross Tie; Cutting and Seasoning of Timber; Scientific Management of Timber Preserving Plants; Efficiency in Plant Operation; Creosote Oil, Specifications and Method of Analysis; Evaporation of Creosote and Crude Oil;

Structure of Commercial Woods in Relation to the Injection of Preservatives; Creosote and Creosoting Oil; Arrangement of Yard, Piling Ties and Timber and Kindred Subjects; Treating Seasoned vs. Unseasoned Ties; Inspectors and Inspection of Material and Treatments at Commercial Plants.

This volume should be of interest to all those who are interested in the preservation of wood.

CALGARY SHOPS, C. P. R.

The Canadian Pacific Ry. has retained Westinghouse, Church, Kerr & Co. as engineers and constructors for its new western shops, which are to be built near the present shops at Calgary, Alberta, Canada. The work includes the design and construction of shops comprising locomotive erecting shop, machine shop, blacksmith shop, boiler shop, tender shop, foundry, planing mill, power house, pattern shop, coach repair and paint shop, freight car repair shop, storeroom and office building, oil house and numerous smaller buildings and structures such as mess building, dry kiln, scrap docks and material bins. The general layout is shown in the illustration.



General Layout of Calgary Shops.

The main shop building will be 712 feet by 306 feet in size and will contain the erecting, machine, blacksmith and boiler shop. The building will be heated by the indirect fan system. The erecting shop will be of the transverse lift-over type and will contain 35 bays of 22 feet each. The machine shop for heavy machine tools will be located parallel to and adjoining the erecting shop on one side and space will be provided alongside of this shop for another machine shop to contain lighter tools. The blacksmith shop will be located parallel to and adjoining the erecting shop, but on the opposite side to the machine shop, and will afford ample space for heavy forging work, steam hammers, etc. Adjoining the end of the blacksmith shop and parallel to the erecting shop will be the boiler shop, next to the high bay of which space is provided for flue shop, boiler shop tools and a flue rattler. In general the construction will be concrete, steel, brick or hollow tile, depending on conditions as yet undetermined.

The foundry will be 80 by 204 feet and will have two bays, the higher of which will be served by an electric crane. This crane will also be used to transfer jib cranes, which can be attached to any of the building columns. The cupolas and charging floors will be at the center of the side bay and core making and snap moulding will also be done in the side bay. The tender and wheel shop is to be an L-shaped building 80x340 feet and will be supplied with an electric crane. The building for the repair of freight cars will be 300 by 231 feet in size, with a saw-tooth roof, and will be adjacent to the lumber yard. There will be eight repair tracks, with a material track between every other one, and one side will be partitioned off into a shop for the forge and woodworking tools. Near this building will be the planing mill, a building 300 by 80 feet with a track through the center. The dry kiln is located nearby. The coach repair and paint shop is 362x146 feet, with 15 tracks at 24-foot centers, and will be served with a 75-foot transfer table. Near one end of the locomotive shop will be the office building and storehouse, 250x60 feet. The office end will be three stories high, the remainder two stories. A 10-ton crane will cover the span between the storehouse and the locomotive shop. Near one end of the storehouse will be the oil house, 42x102 feet in size. The power house will be 84x104 feet and will be equipped with overhead bunkers and a dumping pit for transferring coal to them.

The work of the contractors will include the design and installation of the service equipment in the various buildings, including traveling and jib cranes, wiring systems for shop and yard lighting and power, air and steam piping systems for power and heating purposes, water supply for drinking and fire protection, plumbing and toilet facilities, drainage system, transfer tables and pits, coal and ash-handling equipment, necessary switchboard and transformer sub-stations. J. G. Sullivan, chief engineer Canadian Pacific Railway Co., Western Lines, is in charge of the work. The cost will be about $2,500,000, and it is expected that the shop will be completed by the end of the year.

BLOCK SIGNALS ON THE MISSOURI PACIFIC.

An extensive block signal system is now being installed by the Missouri Pacific-Iron Mountain. When completed

it will cover all the main lines and principal branch lines of the system. Already considerably over 1,000 miles of block signals have been constructed by the company and are in operation. When the plans contemplated have been completed this railroad will have about 3,000 miles of block signals in operation.

The block signal system has recently been completed and is in operation over the entire main line of the Iron Mountain from St. Louis to Texarkana, Ark., a distance of 490 miles, and also over the main line of the Missouri Pacific from St. Louis to Osawatomie, Kans., 60 miles beyond Kansas City. Work is being rapidly pushed from Osawatomie to Peublo, Colo., the Western terminus of the Missouri Pacific main line, and within the next month or two this section will be completed, thus placing both the Missouri Pacific and the Iron Mountain main through lines under block signal over their entire length.

The distance from St. Louis to Pueblo is more than 900 miles. This will be one of the longest straight stretches of track on the continent under block signals. The total distance from Texarkana to St. Louis and thence to Pueblo is 1,400 miles, nearly all of which is already under block. The block system has been completed and is in operation between St. Louis and Omaha, by way of Kansas City, 481 miles.

From Osawatomie block signals are being extended by way of Coffeyville, Kans., and Fort Smith, Ark., to Little Rock, Ark., and it is contemplated to further install the blocks from Little Rock, by way of McGehee, Ark., to Alexandria, La., a distance of 759 miles from Osawatomie. This, when all completed, will give a straight block signal system from Omaha, Nebr., to Alexandria, La., by way of Osawatomie, of 1,017 miles.

From Dupo, Ill., the Missouri Pacific terminal for East St. Louis, block signals are being installed to Paragould, Ark., by way of Illmo, Mo., near the great Thebes bridge. This stretch of 242 miles of track is cojointly operated by the Iron Mountain and Cotton Belt railroads, and the block signals on this part of the line will, of course, be used by both systems.

The Missouri Pacific also has in view installing block signals from Pleasant Hill, Mo., to Joplin, Mo., a distance of 133 miles, and from Bald Knob, Ark., to Memphis, Tenn., 91 miles.

When all this work is completed, both the main and branch lines of the Missouri Pacific-Iron Mountain system over which the traffic is heavy, will be protected by block signals.

The signals being used are the "normal danger" type, so that no train can enter a block until the block is released for it to proceed. This not only protects the train from running into another in front of it, but also protects it from having any other train run into it from the rear.

As an additional precaution and convenience telephones enclosed in booths are to be placed at every sidetrack along the entire area covered by the block signal system, and there will also be telephones in all stations, so that a crew on the sidetrack can communicate at any time by telephone with the train dispatcher and learn the exact conditions of affairs ahead and behind, and when the track will probably be clear for them. If they have noticed any flaw or defect of any kind on the track they can also notify the proper officials at once, and all other trains can be warned and men sent immediately to remedy the trouble.

A GASOLENE WEED BURNER.

Keeping the right-of-way on branch lines free from weeds during the summer months is a troublesome matter to many railroads. On many branch lines, along sidings and commercial tracks that are infrequently used, the roadbeds are ballasted with dirt, and from early spring until late fall the rank growth of weeds is a source of great annoyance and considerable expense. It is a common sight on such roads in the western prairie country for the weeds to be 2 ft. or 3 ft. high, and on commercial tracks seldom used, sunflowers and other rank growths are seen as high as 7 and 8 ft. along both sides of the track. This condition obstructs seriously the movement of trains, causes slippery rails with consequent annoyance in operation, and necessitates considerable reduction in tonnage and thereby a decrease in revenue.

It is absolutely necessary to get rid of this growth at any cost. The pilot of the locomotive has been made use of to some extent by fitting it with knives, but this has not been of much benefit, and in the main it has been necessary for the track department to engage large gangs of men to cut this growth at great expense with scythes and shovels. This cost is practically continuous throughout the summer months, as the growth is as fast as a reasonable number of men can keep pace with. The season at which this work must be done is also the time when laborers are in great demand in the fields, and it is often almost impossible to get the men at any cost during this period. Since on these branch lines the traffic is usually relatively light, the operating officers often begrudge this unproductive outlay for labor. Some time ago the Union Pacific Railroad set about finding some means of doing this work at a minimum cost. Many suggestions were considered, such as cutting the weeds by machinery and sprinkling the right-of-way with a saturated solution of salt and water, which would tend to kill off the weeds; but after numerous experiments in the way of machines for the work, A. L. Mohler, vice-president and general manager, suggested a gasolene weed burner. One was accordingly developed in the Omaha shops under the direction of W. R. McKeen, Jr., then superintendent of motive power, and has been doing the work very successfully and at greatly reduced cost. It is carried on a four-wheel, all-steel car with regulation standard wheels, axles, boxes, pedestals, etc. At one end of the car is a gasolene engine secured to the floor, which propels the car and pumps the air for forcing the gasolene to the burners and elevating the side wings of the burner frame. The propelling mechanism is designed for two speeds, the slower sped of 3 to 4 m. p. h. being used while burning weeds, and the higher one of 12 to 15 m. p. h. in going to and from work.

There are a number of tanks on the car to carry a supply of gasolene sufficient for a day's run on the road. The gasolene is forced by compressed air into a system of burners at the back of the car, arranged to deliver the flame close to the ground. This practically kills the weeds, while cutting them in no way stops the growth, of course. The framework for carrying the piping to which the burners are secured is divided into three sections, the center one of which extends a little beyond the rails. The side sections are hinged to the center section to enable them to be lifted out of the way of obstructions outside of the track and to clear cattle-guards, etc. They can also be set at any elevation in order to bring the burners close to the ground on any kind of grading. With these three sections in operation a strip 12 ft. wide—3½ ft. each side of the rails—is cleared.

It has been found advisable to make a first burning early in the year when the growth has reached a height of 6 to 8 in.; then to go over it again a few days later when it has dried somewhat. In the second burning the weeds are entirely consumed and the roots killed. It is sometimes necessary to repeat this performance three months later. The machine is capable of burning from 20 to 25 miles a day, running about 3 to 4 m. p. h. Three men, all told,

are required in the operation of the device, the car being moved over the road under orders the same as a regular train. Where the weeds are cut by hand it requires approximately 16 men to cut one mile of track per day; hence the machine does the equivalent work of about 300 men. It destroyed the weeds at a cost of $5.75 per mile as against $22.40 per mile when cut by section men.

PINE CREEK BRIDGE, PENNSYLVANIA R. R.

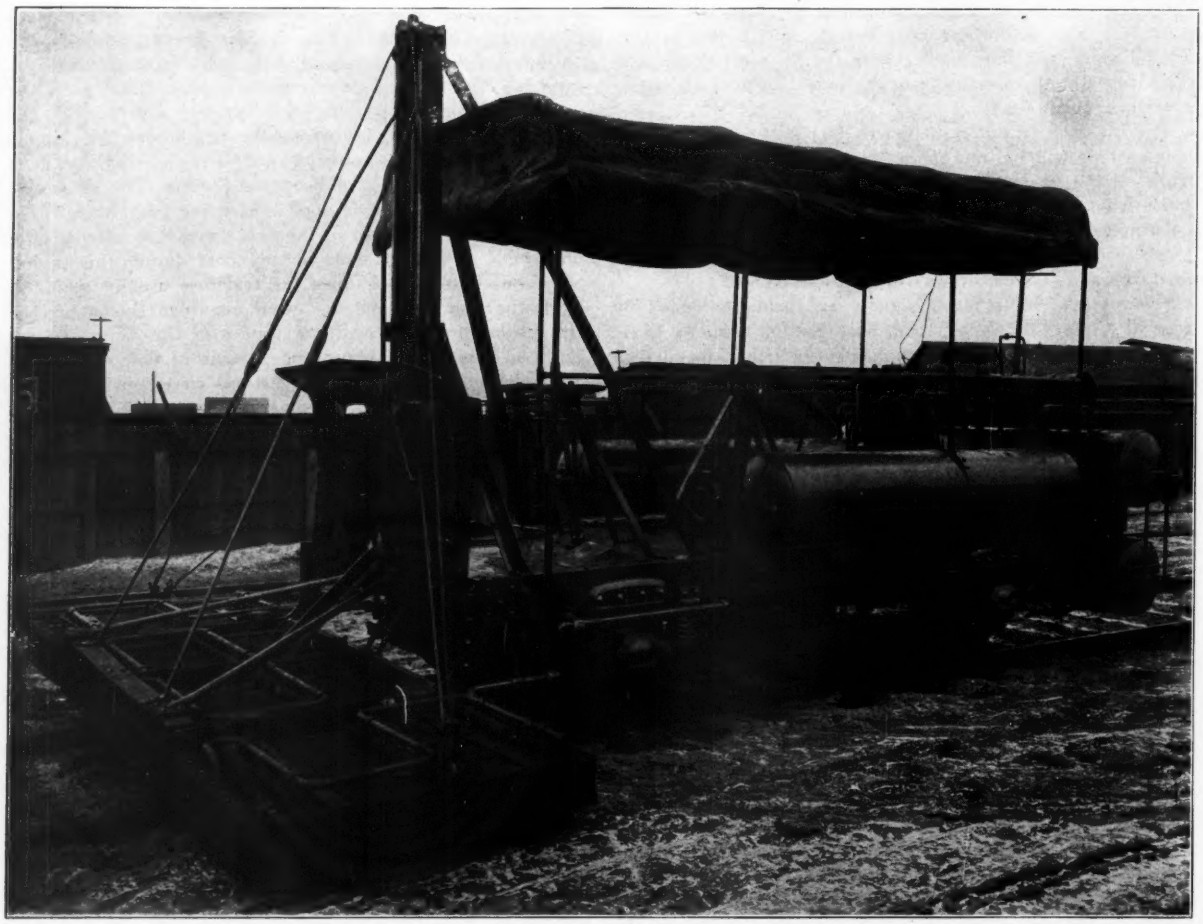
The Pennsylvania recently put in service a reinforced concrete arch over Pine Creek, near Etna, Pa. The bridge is located on a skew, the angle between the abutments and the center line being 57 degrees. The arch has a clear span of 71 ft. 6 ins. at springing line, and carries four tracks.

The arch is the open spandrel type. The mixture used in the arch ring was 1:3:5, using river gravel and sand; the shape of the ring is elliptic. The reinforcement consists of medium steel cold twisted bars at 12-inch centers for those running around the barrel. The longitudinal bars are spaced 2 ft. center to center, and are 5 inches from the intrados. Splices were made by laps tied with No. 8 wire.

The abutments are reinforced concrete with the same mixture as used in the arch ring. The face has a batter of 1½ inches to the foot, and the back is stepped with 8½-inch offsets for each 2 ft. rise. Medium steel deformed bars were used, as shown on the plan. Ten-inch piles 20 ft. long were driven at 3 ft. centers both longitudinally and transversely under each abutment and wing wall.

The top of the barrel slopes on a curve to the parapets, which are at the same height as the top of the ties. The parapets have an inside batter of 1/3 or 4 inches to the foot, while the outside is plumb.

The plan and detail of the centering is shown herewith. The forms were built of 2-inch southern yellow pine placed on 3x6-inch studding at 2 ft. centers, braced sufficiently to give a true surface. After the forms were removed the coping was trowelled with neat cement, and all exposed surfaces were smoothed and corners rounded in accordance with the Pennsylvania standards. The specifications called for weep holes to be placed in the barrel of the arch as directed by the engineer in charge.

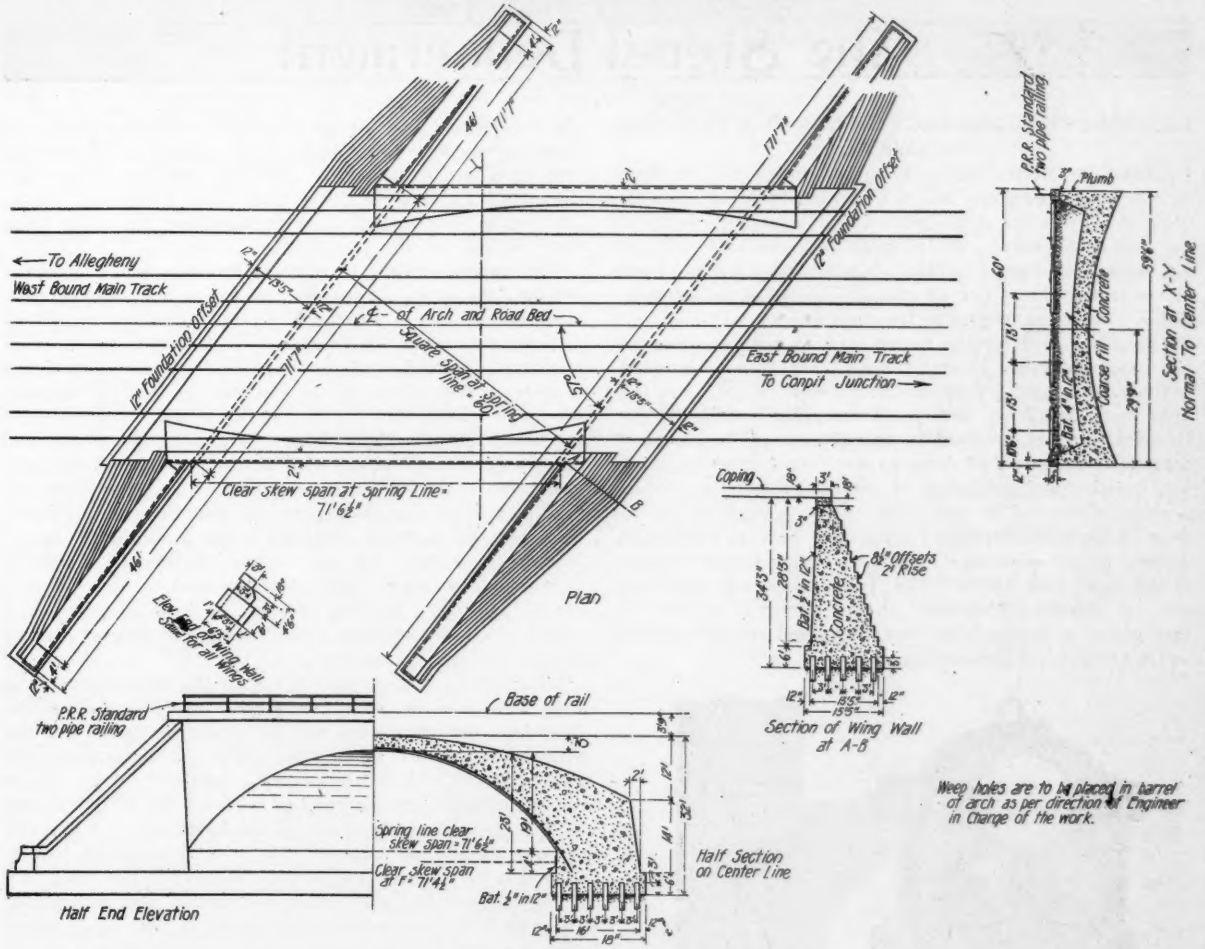


Gasoline Weed Burner, Union Pacific R. R.

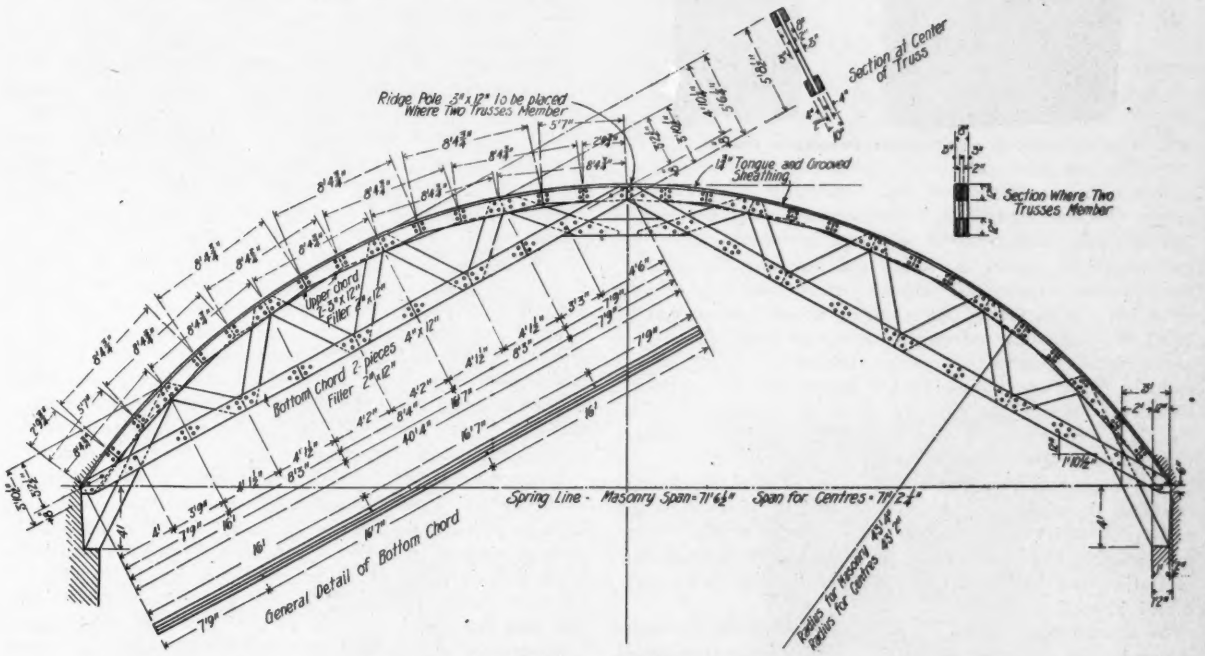
The principal unit prices were as follows:

Cofferdam	$ 2,917
Masonry—Foundation, including excavation and piles 966 cu. yds. @ $13.47	13,015
Masonry—Above foundation, 3,012 cu. yds. @ $5.46	16,451
Filling over arch	574
Pipe railing	94
Temporary material shed and unloading trestle	797
Caring for and shifting tracks	1,380
Cost of removing old girders, etc.	1,172
Total	$36,400

We are indebted to Mr. L. R. Zollinger, engineer maintenance of way, and F. W. Smith, division engineer, for the plans and information presented in this article.


To Allegheny
West Bound Main Track
℄ of Arch and Road Bed
Square span at spring line = 80°
East Bound Main Track
To Conpit Junction
12" Foundation Offset
Clear skew span at spring line = 71'6½"
Plan
Coping
8½" Offsets 2' Rise
Concrete
Bat. ½" in 12"
Section of Wing Wall at A-B
P.R.R. Standard two pipe railing
Base of rail
Spring line clear skew span = 71'6½"
Clear skew span at F = 71'4½"
Half End Elevation
Half Section on Center Line
Weep holes are to be placed in barrel of arch as per direction of Engineer in Charge of the work.
Section at X-Y Normal To Center Line
Coarse fill
Concrete
Plumb

Plan and Sections of Pine Creek Arch, Penn. R. R.


Ridge Pole 3"x12" to be placed Where Two Trusses Member
Section at Center of Truss
½" Tongue and Grooved Sheathing
Section Where Two Trusses Member
Upper Chord
Bottom Chord 2 pieces 4"x12"
Filler 2"x12"
Spring Line - Masonry Span = 71'6½" Span for Centres = 71'2½"
General Detail of Bottom Chord
Radius for Masonry 45'6"
Radius for Centres 45'2"

Centering for Concrete Arch Over Pine Creek.

The Signal Department

INTERMITTENT CONTACT SIGNAL FOR ELECTRIC RAILWAYS.

Signals for electric railways, on account of the difference in operating conditions, depart somewhat radically from the ordinary signals for steam roads. The Type MD Signal of the Nachod Signal Co., Philadelphia, is a combined light and disk signal for electric railways only, operated by the power in the trolley line. The signals are controlled by overhead trolley contactors located at the terminals of the block. As the rails are used for the return traction current these are not easily available for continuous track circuit signaling.

Some advantages of intermittent contact signals are low first cost, simplicity, and small attention required. The electrical circuits involved in this system are so designed that no derangement of them, as would be caused by breaking, crossing and grounding of the line wires, can produce a clear failure. The disk type signal is used in preference to the more expensive semaphore with its mechanism because of the advantage resulting from enclosing the indicating disks from the weather. With the usual semaphore arm, on account of exposure to the elements, a great excess power is required for very occasional weather effects, as ice or snow on the blade.

Fig. 1. Signal Box on Bracket, Permissive Indication.

The signal is shown in Fig. 1 mounted on a pole by means of a cast iron bracket having an adjusting screw. In the normal neutral position with no cars on the block the indications are *neutral*, no lights and no disks, the opening for the disks showing as black; *permissive*, showing a white light and a white disk; *stop*, showing a red light and a red disk. For opposing movements on single track the signals are normally neutral, but a car taking the block—which extends from one siding to the next—sets the opposing signal at stop and the entering signal at permissive. The signals so remain until the car leaving the block restores them both to the normal neutral.

In the operation of setting the signals from the neutral position, the signal indication is located in advance of the trolley contactor some 200 or 300 feet, so that the motorman passing under the contactor can observe through this indication, that he has properly affected the signals and protected himself.

The arrangement of the circuits is such that the car passing under the contactor opens the circuit of the stop signal magnet in the opposing signal, permitting the display of the stop signal there by gravity, and interlocking this by a separate line wire with the permissive signal at the entering end as a return indication. Thus a failure to set a stop signal will also prevent the display of the permissive signal. The signal is actually a three position one, but a car takes the block only on the one position.

The interpretation of the indications is as follows: *Neutral:* the opposing signal is in the same condition. Accept the signal as far as the contactor. *Change from neutral to permissive as car passes contactor:* The opposing signal is at "stop." Proceed through the block at speed under signal protection, block clear. *Stop:* Signals are set for opposing movement. Stop until signal goes to neutral. *Neutral after car passes contactor:* Signal failure. Opposing signal may not be at stop. Communicate with dispatcher and flag through. *Permissive, with an affirmatory change as car passes contactor:* Signals are set for movements in your direction. Enter the block under control expecting to find a train in it. Speed limit must be such that the braking distance corresponding to it and to the track conditions is less than the view ahead—that is full speed in clear weather on level tangents, low speeds in "thick" weather, and when approaching or leaving curves or visual obstructions.

Referring to Fig. 3, with a car in the block proceeding from left to right, should a second car follow into the block, the motorman will not see a neutral signal, but the permissive signal. As he runs under the contactor there will be a blink of the light and a dropping of the white disk to indicate that his car has operated the relay counter. When the first car goes out of the block at the right end the signals are not changed, but when the second leaves, they will be restored to normal. Should a car enter the block say from the left, setting the signals, then in backing out under the same contactor again, it will clear them. Should a car enter an occupied block against a stop signal, the signal at the other end will be set at stop also, and when the car wrongly entering the block backs out again, the signals will be restored to their previous condition as before its entrance.

Referring to Fig. 2 the electrical operation of the signal is as follows: In the normal condition of the block with signals neutral, that is, no lights nor disks showing, the red disk R is prevented from indicating by the continuous energization of the H magnet in each relay, a separate signal wire 7 or 8, and revolving switch 19-4 being used for each stop signal. A car entering the block sends a momentary current through coil A by means of the mechanical trolley switch or by the trolley contactor and directional relay, breaking the circuit at the near relay of the H magnet in the far relay. The far signal therefore goes to the stop indication by gravity, showing a red risk and red light, and when it has done so, closes a circuit through the interlock wire 1, and the magnet D, which exhibits the white disk and white light as a proof that the red disk is showing. The lamps are operated by the disks in such a manner that when the disk comes to an indicating position the circuit of the corresponding lamp behind a semaphore lens is closed.

The arrangement of clearing the signals or restoring them to the normal is general and a car or cars in the block may leave by either end singly or in any combination, the signals showing neutral only when all the cars that have entered the block have left it. Moreover, since the circuits for displaying stop signals are in duplicate and independent, it is evident that cars may reach opposite ends of the block at the same or successive instants with precisely the same ultimate effect on the signal. Also the clearing arrangement is such that

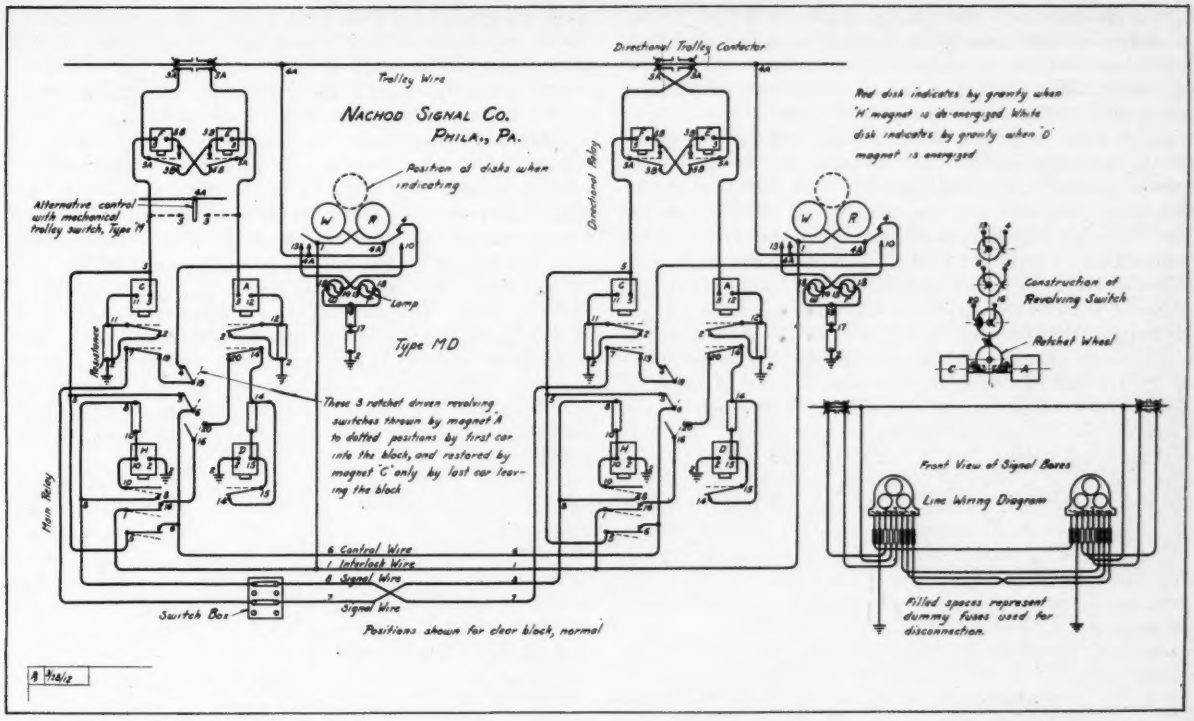

Directional Trolley Contactor
Trolley Wire
NACHOD SIGNAL CO.
PHILA., PA.
Red disk indicates by gravity when 'H' magnet is de-energized White disk indicates by gravity when 'D' magnet is energized
Position of disks when indicating
Alternative control with mechanical trolley switch, Type 'T'
Directional Relay
Lamp
Type MD
Construction of Revolving Switch
Ratchet Wheel
Resistance
These 3 ratchet driven revolving switches thrown by magnet 'A' to dotted positions by first car into the block, and restored by magnet 'C' only by last car leaving the block
Front View of Signal Bases
Line Wiring Diagram
Main Relay
6 Control Wire
1 Interlock Wire
8 Signal Wire
Switch Box
Signal Wire
Positions shown for clear block, normal
Filled spaces represent dummy fuses used for disconnection.

Fig. 2. Wiring Diagram.

Fig. 3.

when a car enters the block against the stop signal, thereby setting a stop signal at the opposing end, on backing out it will restore the signals to the same condition as before its entrance. This results in the following desirable and highly universal operation, very closely simulating the effect of a track circuit: Should a car enter a block, having set signals, and remain there, then cars entering and backing at either end—whether against the permissive signal or the stop signal—will not change the stop signal as set by the first car in the block. After all the cars have left, except the first one, when that one leaves the block the signals will be restored to normal.

The relay unit (Figs. 4 and 5) is an assemblage of four magnets and three resistance units mounted on a terminal board and connected to the outside wiring by spring contacts. The upper pair of magets moves the revolving switch through a ratchet and pawl mechanism and serves to count the cars in the block. The lower pair drives the color disks. All the magnets operate switches in addition. The relay is bolted to the cast-iron upper case containing the signal indications and hangs in a tank of transformer oil. The entire unit is always lubricated, protected against corrosion and cushioned from violent magnet blows by the oil. It is oil cooled, oil insulated, and the switches are oil-break.

Circuits.

The term front contact is used to denote a contact made by an armature when its operating coil is energized, as, for instance, the front contact 1-16 operated by coil H. A back contact is one in which the contact is made when the armature falls away, the coil being de-energized, as 10-8. Also an indicating contact or switch is one closed by the color disk in its indicating position as 4A-10 on the white disk, a non-indicating contact being one closed when the disk does not show as 4A-4.

The direction of cars may affect the signals appropriately by causing them to energize magnet C or A, respectively; and this selection may be made either mechanically by a trolley switch in which a lever is struck by the trolley wheel itself, its movement making one or the other of two electrical contacts, or by an electric selector, comprising the directional trolley contactor shown, without moving parts, and acting in conjunction with a directional relay having coils E and F.

The directional trolley contactor, Fig. 6, consists of two longitudinal sections or halves, each consisting of a pair of strips insulated from the trolley wire, but supported near it so that a metallic trolley wheel riding on the wire will

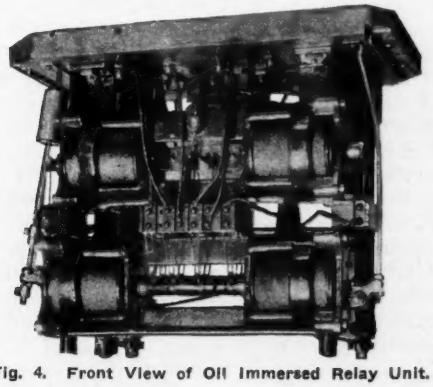


Fig. 4. Front View of Oil Immersed Relay Unit.

Fig. 5. Rear View of Oil Immersed Relay Unit.

connect the strips with the wire by means of its flange. The two halves of the contactor at the insulation are placed so closely together that for an instant the trolley wheel bridges both halves. The wheel does not leave the wire, but touches one or both of the flared and inclined contact strips; these strips, in order to prevent blows at high speed and to maintain a continuous contact, are flexible in themselves and flexibly mounted. The attachment of the contactor to the wire is by standard ears and suspension; and the insulation is through impregnated hickory. It operates the signals at speeds of 55 miles per hour. When a car passes in such a direction that the wheel reaches the end 3A first, a circuit is formed from the trolley wire 4A, strip 3A, back contact 3B, terminal 3B, terminal 3 of coil E to the operating coil A, thence to ground. During this period the armature of coil E is attracted, changing the connection of 5A from 5B to 3B. Then when the car reaches the second half of the contactor 5A, the current continues from trolley wire 4A, wire 5A, front contact 3B, through the same coil E and to operating coil A as before. It will be noted that no current is broken at the back contact 5B, the only requirement being that E must attract its armature before the car reaches the end 5A of the contactor. Since these connections are exactly symmetrical for coil F, it follows that a car running under the contactor so as to touch 5A first will thus energize operating coil C; and by attracting the armature of F will continue to energize that coil when the wheel reaches the second strip 3A.

Fig. 6. Directional Trolley Contactor.

All letters and numbers referring to the right-hand signal are distinguished by a prime (1) in the following description:

When the signals are neutral there is a circuit from the trolley wire 4A, non-indicating switch 4A-4, revolving switch 4-19, back contact 19-7, through a switch box, if one is used, to signal wire 7, entering the other signal relay as 8^1, resistance 8^1-10^1, through coil H^1, by terminals 10^1. 2^1, to ground 2^1. By use of a switch box a track switch not having its points completely closed will set stop signals at both stations.

A car entering the block from the left closes the local circuit from trolley 4A through coil A, terminal 12, back contact 2, ground 2. The armature of coil A rotates the revolving switch one notch, throwing it into the dotted position, and breaking the aforementioned circuit through the H^1 magnet at the revolving switch 4-19. The armature of H^1 being de-energized, falls, and the red disk appears by gravity. When it reaches the indicating position, the indicating contact $4A^1$-1^1 is closed; current then flows from trolley through $4A^1$-1^1 through the interlock wire 1 to the other box, front contact 1-16, revolving switch 16-20, back contact 20-14, resistance 14-15, terminals 15, 2 of coil D, to ground 2. Coil D is thereby energized, attracting its armature and displaying the white disk W, which on indicating closes the indicating switch 4A-10, and lights the white lamp. Thus by switch $4A^1$-1^1 the white disk is interlocked with the red, so that if the red disk should stick in the non-indicating position, the magnet D would not be energized, nor would the white disk indicate. Moreover, it will be evident that this interlocking is mutual; and if, for instance, the white disk W should stick in the indicating position irrespective of the state of coil D, or be raised by hand to that position, then the H^1 magnet would be de-energized by the opening of the non-indicating switch 4A-4 and exhibit red disk R^1. Furthermore, should the H magnet fail on a clear block, either by open circuiting or short circuiting, its armature thereby dropping, the red disk in that box will be displayed, but the corresponding white disk in the other box will not be displayed, since that circuit is open at the revolving switch 16^1-20^1. The foregoing comprise the safety circuits.

Every impulse of current in the magnet A, as by a car passing the contactor to enter the block, rotates the revolving switch one notch in the clock-wise direction, and every impulse of current in coil C, as by a car leaving the block, rotates this switch one notch in the counter clock-wise direction. Therefore, if the signals were neutral with no car in the block, after all the cars that have entered the block have vacated it, they will again assume the neutral position. The clearing magnets C and C^1 with the control wire 6 and its associated revolving switches 5-6 and front contacts 5-6, are used to control the restoration of the signals.

Thus a car going straight through the block from left to right will set permissive signals at the entering end, and stop signals at the leaving end. As it leaves the block at the right hand contactor, it will, it is true, close a local circuit through coil C^1, but this will have no action on the revolving switch, since there is a mechanical stop at its initial position. Current will, however, continue by wire 5^1 through revolving switch 5^1-6^1, through control wire 6 to the left hand signal, thence by means of front contact 6-5 to coil C. The action of this magnet is to restore the revolving switch to its original position, closing contacts 4-19, and opening the circuit of magnet D at 16-20. This magnet being de-energized, the white disk is restored to the non-indicating position, closing the non-indicating switch 4A-4. The circuit through the H^1 magnet is thereby established at 4A-4 and 4-19 as described; the H^1 magnet restoring the red disk R^1 to the non-indicating position. The latter action extinguishes the red light.

Should a car enter the block from the left and back out again under the same contactor, in backing out it will close a local circuit through coil C which will restore the revolving switch to its original position, thereby restoring the signals to neutral, as already described; and, although by means of wire 5, front contact 5-6, control wire 6, and revolving switch 6^1-5^1, current will also energize coil C^1, there will be no rotation at the revolving switch here on account of the mechanical stop.

Should a car enter, say from the left, setting the signals, and a car enter from the right against the stop signal there displayed, then the revolving switches in both relays will be rotated to the dotted position, coils H and H^1 will be de-energized, and stop signals will show in both stations. (When the red disk indicates at a signal, the white disk cannot be displayed there at the same time, since the display of the red opens the circuit of the D magnet at the front contact 1-16. Moreover, the red disk is in front of the white disk and would eclipse it if both were raised by hand.) When the right hand car backs out of the occupied block, it will energize coil C^1 to close the revolving switch at that box only, thereby restoring the signals to the same condition as before its entrance. In energizing coil C^1 there will be no circuit through the control wire 6 to magnet C in the other box, because revolving switch 6-5 is open, and front

contact 6-5 will not be closed while the car is on the contactor. Since the back contact 7^1-19^1, which is in the circuit of the H magnet, is held open by the presence of the car on the contactor, the H magnet will not close the above

The Type MD signal, using four line wires, is particularly well adapted to interurban roads on account of its high safety features.

REPORT OF BLOCK SIGNAL AND TRAIN CONTROL BOARD.

(Continued from Page 133, March Issue.)

The board does not wish to be understood as stating that the conditions of entirely acceptable automatic train control, as formulated by it in the 10 characteristics published in its report of last year, are fully met by any one of the devices it has thus far examined. On the contrary, the art of automatic train control is still largely in the experimental stage; but it is far enough advanced to warrant the installation of available devices with a view to their further development to meet the demands of safety in train operation.

Having in mind the protection of train movements in particularly dangerous locations, the board is convinced that were the use of automatic control devices required in such locations, railway managers would have no difficulty in complying with such a requirement in a manner fully to meet the demands of safety.

Since the disastrous collision on the Baltimore & Ohio at Terra Cotta, D. C., on December 30, 1906, in which 43 persons were killed, accidents of the same character have continued to occur with a frequency which would be appalling had not the American public become accustomed to them. These accidents could have been prevented by the use of automatic train stops.

Few, if any, of the mechanical or electrical elements entering into the construction of automatic train-control systems involve any new principles, nor are they materially different from the elements used by the railways in the everyday operation of their interlocking and block signals, train brakes, and other devices. The ingenuity and initiative which have been manifested by railway engineers in the development of much of the apparatus used in the conduct of railway business greatly exceeds, in the opinion of the board, that required to produce apparatus which can be superimposed upon existing signal systems adequately to compel obedience to the signal indications.

The board does not consider that the question of the actual design and construction of the apparatus necessary for automatic train-control systems has been as great an obstacle in the way of their adoption as the operating questions involved in their use. In view of the manner in which they have been used in the situations where employed, and the skill with which other problems involving the handling of complicated train movements have been met, it is futile to advance any difficulties involved in such a step as an excuse for failure diligently to undertake the development and practical application of such devices to general steam surface railway conditions.

Further, the board has no hesitancy in saying that had the railways directed the same effort toward the development of automatic train-control apparatus that has been devoted to the development of interlocking and block-signaling apparatus, we should now have adequate installations of automatic train-control devices which would permit an engineman to handle his train without interference as long as he did it properly, but would intervene to stop his train if he disregarded a stop signal or ran at excessive speed where speed restriction was prescribed.

The railways have been decidedly lax in developing the automatic stop, and progress has been so slight in this direction that the actual experience which is necessary for the formation of proper legislative judgment is lacking. The board, therefore, does not believe that at the present time legislative compulsion to this end would be wise; it does believe, however, that the railways should be urged and expected to develop the art of automatic train control so as to provide devices which will meet their operating conditions. This appears to the board to be entirely practicable, and should it not be done with a reasonable degree of expedition, steps should be taken by the Government to stimulate such action.

It must not be assumed, however, that the use of automatic devices of any kind will remedy all the faults at present existing in train operation. Such devices can do no more than reduce the percentage of accidents that occur through failure, from any cause, to observe the prescribed conditions of safety. The automatic stop is purely an emergency device, like the fire extinguisher. We do not depend upon fire extinguishers to prevent fires, but when, in spite of our elaborate precautions, a blaze nevertheless starts, the presence of a fire extinguisher near at hand is often the means of forestalling a disastrous conflagration. So with such devices as the automatic stops. They can not insure that the fundamental conditions of safety on railways will be observed, but when the necessary precautions for the prevention of certain classes of train accidents are ignored, they may intervene to forestall the accident which might otherwise happen. But when all is said that can be said in favor of the use of automatic safety devices, it still remains true that they correct none of the fundamental defects in American railway practice.

General Conditions Affecting Safety.

It is unquestionable that, notwithstanding the increased safety due to the extension of the block system during the last 10 years and to the increasing use of safety appliances, there is no sensible diminution in the total of railway casualties.

A careful study of statistics will disclose that the accidents which occur year after year with such dreadful monotony are due to substantially the same causes, thus showing that methods of railway operation have not kept pace with the needs of development.

The fact which has most strongly impressed the board is the lack of some central authority with power adequately to deal with the subject of safety in all its phases. The trouble with all railway safety legislation thus far seems to be that it has only attempted to deal with the problem in piecemeal fashion. A certain glaring evil has manifested itself or has been brought into prominence by the occurrence of a particularly distressing accident or series of accidents, and this has led to demands for legislation to deal with the particular evil thus disclosed. Such is the force that has placed the safety-appliance, hours-of-service, boiler-inspection, and accident-investigation laws upon the Federal statute books, and such is the force which is now demanding legislation compelling the use of the block system and automatic train stops, uniform signals, steel passenger cars, uniform clearance conditions, and better manning of trains.

Much of this piecemeal legislation has resulted in good, and there can be no doubt that it has greatly contributed to safety. The safety-appliance acts particularly have been of inestimable benefit to employees. But it is nevertheless true that legislation of this character lacks correlation, multiplies administrative functions, and duplicates work. It very naturally causes irritation and resentment on the part of railway managers, because they know not where it is going to stop and have constantly to create new functionaries and introduce changes in their already complex organizations in order to meet its demands. Finally, it produces results not at all commensurate with its cost both to the public and the railroads. Furthermore, there are many matters in connection with railway operation, having a vitally important bearing upon safety—comparatively unimportant each in itself and yet most important when taken in the aggregate—which are now being totally neglected simply because Congress does not take the time and trouble to consider them and legislate on them in detail.

Any further legislation dealing with safety in railway operation, to be fully effective, should deal as comprehensively with the whole subject of the physical operation of railroads as ex-

isting law now deals with the subjects of railway rates and accounts. There is ample justification for this, as it goes without saying that any measure which has for its object the saving of life is of vastly greater importance than legislation dealing with the financial operations of the railways.

It is the opinion of the board that with respect to the matter of safety the time has come in this country to inaugurate a system of supervision over interstate roads somewhat similar in character to that now administered through the British Board of Trade. An organization should be created having ample, though carefully restricted, powers of investigation and inspection, as well as of administration of laws sufficiently broad to insure adequate regulation of the details of construction, maintenance, and operation of all interstate roads, so far as concerns the safety of railroad travel and employment.

Such a body should assume control of the functions now comprehended under the various safety-appliance, boiler-inspection, hours of service, and accident-investigation laws, and in addition should take cognizance of matters relating to personnel, methods of operation, and the physical construction of railroads, as well as the condition of roadway, track and equipment, and should have authority to require repairs or changes to be made when necessary to remedy dangerous conditions. It should supervise train schedules, in so far as safety in train operation might be affected by the physical condition of roadway and the use or nonuse of means to promote safety; in short, it should deal as comprehensively with the question of safety on interstate railroads as State railroad commissions now deal with the question on the railroads under their jurisdiction.

The only progress thus far made in securing greater safety in railroad operation has resulted directly from publicty. While publicity is undoubtedly a powerful influence, it is too much like a weathercock, which points only when the wind blows, and, if undirected, it can not logically be expected to accomplish more in the future than it has in the past. The experience of the past affords abundant reason for not delaying longer, and any experience to be expected in the future, so far as it can aid in forming judgment on the necessity of legislation recommended at this time, can only be cumulative in character and simply confirmatory of the judgment now formed.

The board's recommendations are the result of four and one-half years of special study, investigation, and observation; and besides this actual experience with conditions existing in this country there has been available to the board the experience of other countries, all of which has been considered. It is believed, therefor, that any further study could only result in more specific recommendation—such recommendation, in fact, as should form no part of the general legislation proposed. Any further study should be conducted by the railroads themselves, acting in co-operation with and under the guidance of such a central authority as is here indicated. Such co-operation is believed to be absolutely necessary if the results obtained are to be homogeneous in character and of any real and lasting benefit. Notwithstanding the organization which individual railroads can bring into service to solve the problems confronting them, it is hopeless to expect that any adequate solution can be brought about by the railroads acting independently.

RAILWAY SIGNALING.*

By J. M. Fitzgerald.

The enormous increase in the amount of traffic to be handled with only slight increase in trackage, together with the fallibility of the signalman operating the signals, lead to the development and use of automatic block signals; in other words, block signaling has been more or less of an evolution.

In the first installation of manual block signals, the signal was located at the stations. The station agent, as at present, was "jack-of-all-trades," and as traffic increased, the agent's various duties prevented him from giving the strict attention to the blocking that he should, and the manual system was shown to be more or less unreliable.

The next move was to install block stations with men operating them, whose sole duty was the operation of the signal system; nevertheless, these men were still human,—made mistakes, and gave wrong signals.

The number of accidents due to these mistakes increased even faster than increase in the train service, and this lead to the installation of controlled manual signals, requiring the co-operation of the block operators at both ends of the block, by electrical means, before the "proceed" indication could be given for the train to enter the block.

The early forms of controlled manual block signals comprise a manually operated signal at each block station, and an electric lock so arranged that the simultaneous action of the two operators was necessary to obtain the "clear" indication. This form gave but a limited amount of protection, not enough to long satisfy the demands of the constantly increasing traffic, so that improvements and additions were devised from time to time. The result was that several forms of the controlled manual block were devised, each distinct in themselves.

The application of the electric block to each block signal furnished a certain amount of protection, so that instead of one man being able to give a "false" indication, by mistake, it took two men to commit the same error at the same time, to let a train proceed under a "clear" signal, into a block already occupied. Although the error on the part of two operators is less likely to happen, there is nothing provided in the simplest form of controlled manual block to prevent it. There existed also the possibility that all the signals might be left permanently "clear," as when each man, receiving his unlock once, does not restore his signal to the "stop" position. To overcome this difficulty, slots were provided for the signals, making them semi-automatic, a short track circuit at each station enabling train wheels to restore the signal to danger; after which, a new unlock must be obtained for the next operation of clearing the signal. This was called controlled manual with station track circuit. Although this system corrected one of the defects, it did not provide for the contingency of a possible error on the part of both operators. Releasing devices were then attached to the machine to keep the operator from giving an unlock to the other operator a second time until the track between the two block stations was clear—the wheels of the train passing over the circuit operating the electric slot on the home signal, restoring that signal to "stop" position as it entered the block, and holding it in that "stop" position until the last wheels of the train have passed over the track circuit and have operated the releasing mechanism at the end of the block.

This arrangement afforded protection against the combined error of two operators, but still a train might have broken in two, leaving part of the train in the block between the two stations, and the operator not noticing the absence of the markers of the tail end on the train passing into his block, could give the unlock. To guard against this possibility of action, the track circuit was extended to cover the total length of the block. This gives a complete absolute block and is called the controlled manual with complete track ciruit. When this form of block system is used permissibly, *i. e.*, a second train is allowed to enter the block under a clearance card or order, the second train is fully aware of the conditions of the block, and proceeds accordingly.

An automatic block signal must be a permissive signal, for if a signal is out of order and assumes the "stop" position, traffic must not be entirely suspended for several hours.

On double track lines, this permissive feature is not serious for after stopping at a signal out of order the train may proceed with "caution" through the block expecting to find another train or a switch misplaced or a rail broken.

On single track lines, however, the delay becomes serious, as when a train receives a "stop" signal, it is necessary to protect this advance by sending a flagman ahead of the train through the block.

*From a paper given before the New England Railroad Club.

The Maintenance of Way Department

CASH PRIZE COMPETITION.

Railway Engineering and Maintenance of Way announces a series of contests on subjects of interest to maintenance of way men. To the writer presenting the best article in each contest a prize of $25.00 in cash will be given. The second prize will be $15.00. Of the other articles submitted all which are published will be paid for at regular rates which will amply repay the effort and time spent.

In announcing this series of contests we are continuing the policy of the old "Roadmaster and Foreman," which was merged with *Railway Engineering* in May, 1911. The first contest in this country on articles from track men was carried on by "Roadmaster and Foreman.".

The first contest will close July 15. As far as possible the papers will be published as received. On July 15th, all papers received will be submitted to the judges, including both those which have and those which have not been printed.

The prizes for the first contest will be announced in the August issue, at which time the cash prizes and all payments for other articles used will be mailed.

The labor question is becoming more serious every year, both in the maintenance of way and construction departments. It is frequently the case that regular section gangs must be filled up during the summer months of each year, with extra laborers, and possibly with a different class and nationality each succeeding year. Many maintenance men have had wide experience with labor and have developed definite policies for handling men to advantage. We are desirous of bringing out ideas along the following lines for the first contest: How do you obtain your labor for (1) section gangs; (2) extra gangs? What inducements or arrangements do you make to keep laborers satisfied and to hold them? Do the laborers you are getting make good track men? Is it difficult to get a fair day's work from the men? What special methods, if any, do you take to increase the amount of work accomplished? Do you find that laborers accomplish more when treated considerately, or when the foreman "drives" them? What do you consider of greatest importance in getting track work done? What suggestions can you make for obtaining better laborers, for increasing the efficiency of track forces?

You can submit an article covering all the above points, or one covering any points which you choose, the purpose being to obtain ideas which will help others in charge of maintenance, or to bring forth information which will give other Officials ideas for improving the conditions.

The award of the prizes will be made by a committee of men prominent in the railway field. All papers entered in this contest must be in this office by July 15.

Address all letters plainly to Editor Railway Engineering, 431 South Dearborn street, Chicago, Ill.

TROUBLE FOR THE EDITOR.

Editor, Railway Engineering:

In a special article on the American Railway Engineering Association in the March issue of *Railway Engineering and Maintenance of Way*, Mr. Francis W. Lane, after paying glowing tributes to the past or early history of that Association, mentions the Roadmasters and Maintenance of Way Association of America, as "Formerly an organization of considerable influence in Maintenance of Way matters," an assertion with certainly very little grace to it and taken literally, utterly devoid of truth, for I would have Mr. Lane understand that the Association with his bann on it, is as much alive today as it ever was, and if he will take the trouble to look up our records, which I will have sent him if he does not possess them, will see that we discuss as important questions at our conventions and in as intelligent a manner and as large a per cent of our members take part in our discussions as does the association he writes of; that we use as up-to-date and as positive methods to get our approved papers made a part of the working methods of the railway world, conduct our business, enroll as many new members, have as large and active membership, and have our Association in as good a financial standing, with as able Executive Officers as there are in any similar association in the country today.

We have the greatest respect for the American Railway Engineering Association, number among its members our most respected and warmest friends, even from its infancy, and I am sure it would grieve some of those truly eminent railroad men whose names he mentions, but who are now no more, to hear or see one disparaging word said about the Roadmasters and Maintenance of Way Association.

That there is a gradually growing field for both Associations, goes without saying. Our interests are strictly one, and will be fostered by every known means by us; and we know it is reciprocated by the engineers who magnanimously open their membership to us, and we gratefully do the same to them, so that there is no "Formerly" to us, but a living and moving fact of 20th century dimensions. If Mr. Lane would take the trouble to inform himself, and if he was informed, he would not try to build up one fabric by demolishing another, which certainly does not sit well with the multitude of readers of *Railway Engineering and Maintenance of Way* who are proud to be members of our Association which will have the honor of celebrating its 30th anniversary in Buffalo next September.

Yours very truly,

(Signed) A. M. Clough.

MACHINING TIES.

Editor Railway Engineering:

The proposition of adzing and boring ties for drive spikes in a tie that is to be treated is an entirely different thing than adzing and boring ties when they are not to be treated.

There is little question in my mind that the advantage of so handling treated ties far outweighs the disadvantage and inconvenience of having it done. It is, true, as you state, that information as to the base, weight of rail, etc., must be at hand a considerable period of time to advance the work and that maintenance forces must be carefully advised of the distribution of ties to see that they are placed under the rail intended. There is also considerable expense involved in hauling of ties and the handling of them, but these I think form the entire line of objections.

The advantages are many:—that of having both rails in the same plane; that of having perfect gauge; that of having uniform bearing for the rail, or for the tie plate on which the rail rests, and that of additional inspection of the ties themselves.

Whether or not a tie that is not to be treated should be

adzed and bored, however, should be governed by the fact as to whether or not it is most liable to fail in service from decay or from spike killing and rail cutting. In a treated tie we aim and, I believe, are successful in prolonging the chemical life of the material beyond—and probably far beyond—its mechanical life, and so in order to justify the investment for treatment, we should expend an amount that would elongate the mechanical life of the tie in the same ratio. To do this it is necessary usually to apply tie plates and to properly apply tie plates in such a manner as to minimize the breakage of the rail, give good gauge and properly construct track, it is essential that the ties should be adzed.

I think that the method of fastening the rail to the tie with hook headed spikes is one that has been considered for years by all engineers simply as an expedient. There is little that can be said in its favor over the screw spike, and I am of the opinion that except for the expense alone, there is no reason why screw spikes should not be used in all treated ties. I am, however, very doubtful as to the advantage in drilling either treated or untreated ties for drive spikes. It may be in treated ties the less destruction of the wood fibre and better penetration of the preservative, due to having an open hole at the point where it is most needed, would pay for the handling, but I do not believe in untreated ties that it would pay at all, for on our road at least, almost all our untreated ties fail from decay rather than from destruction.

(Signed) G. P. Smith, Chief Engineer,
C., C., C. & St. L. Ry.

Editor Railway Engineering:

There are a good many questions involved in the adzing and boring of ties which cannot be answered generally.

There are locations where ties are used that such work would be justified. There are other locations where it would not.

With treated ties it will soon become almost a necessity, but with untreated ties it will probably be a long time before the extra cost and expense is warranted.

(Signed) Geo. W. Kittredge, Chief Engineer,
N. Y. C. & H. R. R. R.

Editor Railway Engineering:

Referring to the practice of this road in boring and adzing ties: I would advise that this company, in conjunction with the Philadelphia & Reading and the Reading Coal & Iron Co., has recently commenced to creosote all ties at the Port Reading creosoting plant which is controlled jointly by them.

In connection with this work it has been decided by this company to have all ordinary cross ties bored for the spikes before being creosoted. The two principal objects in doing this are (first) to get as much creosote oil as possible in the portion of the tie most likely to be subjected to decay and (second) to provide a hole into which to drive the spike with a minimum destruction of the wood fibres consistent with the necessary holding power. It is also the intention to adz the ties at the plant at the same time the holes are being bored for the spikes.

Up to this time we have had no actual experience with ties thus bored. By experiment, however, we have determined to use a half-inch diameter hole in both yellow pine and ordinary oak ties.

Some consideration has been given to changing the spacing of the spikes to secure a uniform boring of all ties, but up to this time no definite conclusion has been reached. The first of the ties are to be bored to suit the present spacing of the holes in our tie plates, making two sets of borings, one for the joint ties and the other for the intermediate ties.

We are making no attempt to change the boring for rails of different widths at the base. In case the variation is too great for the spikes to be driven into the bored holes it is our intention to plug the holes and drive the spikes where necessary. Even when this is done the extra quantity of creosote under the rail will probably be of sufficient value to offset the added expense.

(Signed) Jos. O. Osgood, Chief Engineer,
Central R. R. of New Jersey.

Editor Railway Engineering:

I am of opinion, that where treated ties are to be used, it would, undoubtedly, be economical, to adz the ties for tie plates, and bore for driven spikes, before they were delivered along the right of way. Where the ties are not treated, the machining would not be so easy to handle, except in cases where they were delivered in very large lots and the work could be done at the mills, or where it is necessary to handle them at some one delivery point on the railroad.

Where untreated ties are purchased locally along the railroad, the expense of handling machining would probably be greater than the additional cost of adzing by hand and either driving the spike without boring, or boring after the ties were put under rail.

The advantages of lesser destruction of wood fibre, increased holding power, better and easier driving of spikes, etc., would undoubtedly pay for the machine work being done at some central point, wherever it is possible to do this.

I believe that there is more money to be saved in the matter of adzing for tie plates, than there is in boring for spikes.

In regard to handling of ties for different sections of rail: I do not believe that this would present a great difficulty, as it is known ahead of time where the ties are to be distributed, and ties for the different sections of rail could readily be marked as they were machined, so that in distributing, they could be forwarded to the proper territory.

(Signed) F. B. Freeman, Chief Engineer,
Boston & Albany.

Editor Railway Engineering:

Where ties are to be treated, I would by all means adz and bore them for two reasons, first, the adzing takes them out of wind, which gives a full bearing to the rail, or the tie plates where they are used, without cutting of the treated material, and second, the boring allows the treatment to enter the wood around the spike hole, where in soft wood ties especially, decay begins owing to water following down the spikes.

Where ties are not to be treated, I believe we are warranted in adzing and boring them, first to get the benefit of the full bearing of the rail, as mentioned above, second, to insure the spikes being driven vertical, that the gauge may be kept uniform, and for the further reason that the fibre of the wood is not broken down to any great extent in driving the spike into a bored hole, and it therefore not only has a greater resistance to drawing, but also has a greater resistance to widening the gauge, as the wood naturally gives less where you have the ends of the fibre against the spike, than where you have the side of a broken down fibre.

(Signed) C. A. Morse, Chief Engineer,
A., T. & S. F. Ry.

RELAYING TRACK AND RENEWING TIES.

Editor Railway Engineering:

Rail should not be strung up before laying in track, but set in one rail at a time, for the reason it can be laid just as fast, if not faster, by setting in a rail at a time and the expansion can then be kept regular. The rail will go under the old spike much better and the adzing for the angle bars at joints and pulling inside spikes where the angle bars come will not be done by guess work. If rail is coupled up before laying and then thrown in with bars it will run ahead on the high side of curves and pull back on the low side, causing joints to be very uneven. The expansion will open on the low side of the curve and tighten up on high side, causing too much expansion on low side and not enough on the high side. When laying rail of a wider base than the rail which comes out, much labor can be saved in the adzing sometimes by laying both rails from the outside if it does not affect the gauge too much. By only adzing such ties as are cut down very bad, the wood will straighten up the rail level. The prevailing way is to lay one rail from the outside and the other from the inside, but the above way is a good one under proper conditions. I am in favor of broken joints either on tangent or curves, as I have found track is much easier kept in line gauge and surface this way.

Ordinarily ties should not be renewed out of a face for the reason that some ties rot quicker than others even when of the same kind of wood. Some will be more dotted than others, and if different kinds of wood some will last for years longer than others and much unnecessary labor would be spent in renewing them out of a face. Where track is in a paved street or in a place where it is buried up in ballast as through a town, it is sometimes economy to renew ties out of a face. Any ties that would last a year or more which are taken out can be put in some siding not as important. Much material and labor would be wasted in taking ties out of face under most conditions.

Roadmaster, C. & N. W. Ry.

Editor Railway Engineering:

When relaying I prefer placing one rail at a time for the following reasons:

(1) In cases where the old rail is canted and the ties not properly adzed, this defect can readily be seen and the rail removed and the tie properly adzed.

(2) Expansion is easier to regulate and maintain while the rail is being put in place.

(3) The centers can be more closely watched.

(4) The angle bars can be put on and adjusted more rapidly when the rail is lying level.

In the renewal of ties I prefer single tie renewals for the following reasons:

(1) The road bed is not disturbed to any great extent.

(2) The surface is left in better condition.

I also prefer making all tie renewals first over the entire section and then have the gang drop back and put the track in line, surface, dress the ballast, cut the grass line, tighten the bolts and put every thing in first-class shape. By doing this the ties which have been renewed have a chance to bed; hence when you start surfacing the new ties will be bedded and as a result the tamping will be about the same as that required for the old ties which were not removed.

Supervisor, C. C. C. & St. L. Ry.

Editor Railway Engineering:

It is my practice to place one rail in at a time in connection with relaying track. Better results are obtained by this method. The expansion will be better maintained and the work will progress more rapidly. This method of laying rail can be followed under usual conditions. There are places, however, where it may be advisable to set a string of rails alongside of track and throw them in, due to heavy traffic conditions where there is limited room and time interval between trains or where the force is not ample to properly lay rail. It may be laid by setting it up along track and throwing it in; however, it is not an economical method.

In relation to tie renewals, we make these continuously, that is, taking out just bad ties and leaving the other ties in place except at highway crossings or station platforms where it may be advisable to renew ties to a face, ties which are removed fit for use being replaced at some other portion of the track. Under no other conditions are ties removed to a face.

Division Engineer, New York Central.

Editor Railway Engineering:

I favor relaying track by placing one rail at a time, for the reason that the proper expansion can be better maintained.

I also prefer single tie renewals, for the reason that if ties are renewed to face, ties are apt to be taken out that would last another year. I would not recommend renewing ties to face unless it is intended to use the ties that are taken out and fit for further use in side tracks.

General Roadmaster, Grand Trunk Ry.

Editor Railway Engineering:

I favor relaying track by laying one rail at a time, for two reasons: First, you can place your shims and get a more even expansion than you could by stringing the rail. And second, it is an easier way to pass trains than to string it out, as you can apply your points, and pass trains with but very little delay, if any.

I prefer renewing ties by single tie renewal. By this method you will apply from three to four ties per year to each 30-ft. rail, and in a course of seven years, you will have your track newly tied. Also the single-tie renewal is a safer way for two reasons: First, foreman can keep his track in safe condition for passage of trains while thus engaged in the work of putting in ties. And second, I don't consider track that is tied out of face at the end of seven years safe, as it would all have to be tied over in a course of seven or eight years, and 'twould get unsafe before you could tie track out of face, with the small gangs that most roads have.

Roadmaster, M. K. & T. Ry.

RAIL RAVELINGS.

Dear Dad:

Well, the spring work is here. They have been keeping us busy lately taking out shims and trying to keep the ditches fairly clean in the cuts. I was figuring on having a snap this summer; with all new ties in the main line and no renewals to bother me, I did not figure that the work would be heavy. And the whole track must have a general raise which would mean some help from the extra gang. But the Roadmaster came along the other day, and told me I was to take charge of the first mile north of the station, and this is old track, with poor ballast. This mile of track is in poor condition, and we will have to put in a whole lot of ties. There was an order put in for 700 and these just came last week. As usual, they came in box cars, two of them. I ordered a work train and got my small crew started unloading at about 10:30 one morning. Yes, we had the usual difficulty with the operating department. The engine didn't show up at 7:00; and we waited around until 8:00 A. M. Couldn't get away to do any work be-

cause we expected the train every minute. Why is it that somebody doesn't make the officials understand what it costs to delay a gang of laborers? In this case the loss was not as great as in the many cases I remember when we had 40 to 100 men delayed for the train. Finally at 8:00 A. M. I wired the superintendent and got an answer in another hour that the engine would be there shortly, and then it arrived at 10:30!

We distributed the ties from the train while moving, spotting them from the telegraph poles. I figured that an even distribution of 20 to each 150 feet (which is the distance between telegraph poles) would just cover the mile. This was the best distribution I could make as I didn't have time to go out and spot the rotten ties. However, I think that we won't have to do much carrying. Certainly not as much as if we had unloaded into piles. I placed one man in charge in each car with instructions to unload 10 ties between poles. They distributed them as nearly even as possible. There were eight kegs of spikes, which we had loaded on a flat car. One man was left on this car and unloaded one keg at every fourth pole, as I figured this would give me the correct number of spikes; there are about 400 to a keg.

I expect to start right away and put these ties in the track. There are a few exceptionally bad spots in my new track, which will need attention, but most of it I can leave until the extra gang gets to it.

The Roadmaster is expecting me to put in from 12 to 15 ties per man per day. I told him that it couldn't be done with the kind of labor we have, but he says the other foremen are doing it. I doubt that, but at any rate they are reporting that they do that much. That is a case where the biggest liar gets the most credit. What would you do?

It may be that I won't have to put many of these ties in. The roadmaster was talking about extra gangs yesterday, and incidentally asked me if there was a man who could take charge of my section if I should ever happen to be absent. Hope they do give me an extra gang. In this case I would go over my own section with the extra gang, and so would get it in pretty good shape. It isn't quite so nice when you have to leave your section for all summer, and depend on another man to get it in shape.

So in your next letter you might give me some pointers on surfacing. If they give me an extra gang I want to give them their money's worth. You know I have not done as much surfacing as other kinds of work, and so am not up in it.

I hope that I won't ever have as much trouble with any gang as I did with that bunch I had to discharge outright. You remember what a time I had with them. They sent me out to take the place of a foreman and assistant who they told me were not doing the work as they ought to. These men were a good many years older than I, and, of course, they resented it when I handed them the letter. One of them was all right, however, and didn't have it in for me. He was an old hobo foreman, and was sick of his job. Well, I had an awful time with the men (foreigners), trying to get a day's work done. After I had been there a few days some facts came out which explained why it was so hard to get any work out of the men. The general foreman was a weak member. He had tried to discharge one of the interpreters, who promptly called off the whole gang, and then the general foreman put them back to work and let the interpreter remain. Of course, men were pretty scarce, but only a week before there was an opportunity to obtain a new gang from headquarters. If you had been that general foreman, what would you have done? Here is what I would have done. In the first place I would fire the whole gang when the interpreter quit, unless I had positive orders not to. If I had such orders I would put up a mighty strong bluff, and send them all to the camp for the rest of the day. If that didn't do any good, I would back down as gracefully as possible. Then I would have done everything to get a new gang, and just as soon as I got a new bunch I would have let the others go. Of course, after the general foreman had backed down, those men figured they owned the job.

Those fellows were simply holding up the company. There were only 32 laborers, and they made the company pay 4 cooks, and 2 interpreters. They wouldn't work a minute overtime without double pay, and they always loafed as much as possible to get the maximum overtime. The company payed the six loafers but they couldn't afford me a timekeeper. I had an assistant foreman, and a good one, too, but he was a foreigner. He could talk 4 languages, but couldn't write English.

I was with that gang for 2 weeks, but if I had known all the circumstances in the case, I would never have taken the job at all. The last day I worked them we accomplished just twice as much as the first day; and even that wasn't more than half a day's work. However, the work (surfacing) was done right; it was new track and the other foreman never gave it a high enough raise. We gave it from 6 to 10 inches, and in one place 13 inches, and after that that track stayed up.

Possibly that gang of men could have been broken in to do a fair day's work, but it would have taken a long time. I repeatedly told the general foreman to get rid of them, and told him I never worked men who did so little. Finally he gave me permission to discharge them, and I certainly felt good over it. He threw the message off the back of a train. I read it but didn't say anything to the men about it. Instead of stacking the tools that night, we loaded everything and took it to camp. After the tools were all put away, I notified the men to come around in the morning and get their time tickets. There were only 4 Americans in that camp, and we rather expected a demonstration, but there was none. That night I wrote time tickets till 12 o'clock. The next morning they came to my car, and I let them in one at a time for their checks. And here is the funny part of it. The section foreman wanted 8 men, and they nearly fought with each other to see who should stay. Does not that prove conclusively that a good, strong bluff, when the interpreter called them off would have brought them to time? As far as I'm concerned, I wouldn't have an interpreter on any job if I could help it. They are a big hindrance rather than a help. You get better results by having an assistant of the same nationality as the men. If I didn't know of a good assistant, I would make a careful selection from the gang, and then make a good man out of him, if possible. Let me have some pointers on the above as soon as possible. Yours,

A DAY WITH TRACK-LAYING MACHINE.

By C. L. V.

A lively tattoo, beaten with a club, by the "bull cook" (night watchman), on the side of each bunk car in camp at 5:30 a. m., awoke the sleeping "bos" and brought a series of remonstrances in all kinds of tones and several different languages, at the vigorousness of the attack, but the said B. C. kept calmly on until every man in the camp was fully awake.

At 6 o'clock, another tattoo, this time made by the head chef, with a sledge hammer on a piece of rail suspended from the roof of the kitchen car, brings the men swarming from their "side-door sleepers" to partake of a hearty breakfast of well-cooked food. At 6:30 the general foreman's

cheery voice, calling "les go," brings the few laggards not already on the train out with a rush and we are off for the "front," arriving there at 6:45, the run being a short one. The order "hang your trams" gets every body busy, the "rust eaters" and "tie buckers" putting up the steel trams and the spikers, nippers, bolters and remaining men, putting up the tie trams.

At 7:15 everything is ready, the men all at their stations and the actual work of laying track begins.

Everything moves off like clock work, fourteen men "bucking" ties at the front, four men with the pole man on the derrick placing the rails, twenty-four spikers with twelve nippers spiking the track in full behind the train as fast as it moves ahead. Sandwiched between the tie buckers and spikers are the steel rollers, tie tramers, spike, bolt, and plate peddlers, bridle men, angle bar man, strap hangers, head bolters, etc. The movement ahead goes steadily on, every man compelled by the force of circumstances to do his part and do it on time. There is no chance for shirking, and every man knows that when the material on the train is all in the track and the trams taken down his half day's work is done.

At 10:45, three and one-half hours after the machine was started, a long blast on the dinky engine whistle notifies the men that the last rail has been laid. A glance at the station number ahead of the Pioneer discloses the fact that 5,400 feet of track has been laid for the forenoon's work.

About 30 minutes is consumed in taking down the trams, and we arrive in camp for dinner at 11:50.

At 12:35 "les go" again rings out, and the empty cars having been "set out," and the loaded ones brought out by the "swing train" for the afternoon's work "picked up" we are off with another mile of material. At 1:30 the trams are up and the rails and ties moving.

The general foreman is seen moving tirelessly back and forth, giving a word of instruction here, a command there, and directing his assistants, of whom there are three. One, the "heeler," has charge of the work in front; another is on the "race course," having charge of the "tie tramers," the men who place the ties in the trams. There are 660 feet of tie trams for him to watch, hence the name "race course." The third assistant has charge of the spikers, back bolters and all work behind the train.

The inspector for the company (the track is being laid by contract) is also on the alert, watching the details of the work, occasionally consulting a thermometer to determine the correct thickness of the expansion shim to be used, and consulting with the general foreman in regard to the work.

The work moves on without a hitch and at 4:40 the whistle again announces that the last rail on the train has been laid. Five thousand three hundred feet is shown for the afternoon's work. At 5:40 we are back in camp, tired and dusty, but well satisfied with having laid a little over two miles of track. One hundred and twenty-five men comprised the crew for the above day's work. Two miles of track is considered a moderate day's work. The writer has been with a Robert's machine when no train was taken out with less than a mile and a quarter; and on some jobs one mile and a half was carried on each train and three miles of track laid for a day's work.

The Portland Terminal, Portland, Me., a subsidiary of the Boston & Maine, is planning the construction of improvements in Portland and Westbrook which will involve the expenditure of about $2,000,000. A station will be built on Brighton Ave., Portland, and there will be a new double-track line of more than six miles through the Deering district.

COST OF TRACK LAYING ON THE ERIE.*

In 1905 and 1906, while engineer of maintenance of way of the Buffalo & Susquehanna, I was in direct charge of all track laying, ballasting, etc., between Wellsville and Buffalo, and had, previous to this time, charge of all the track laying of the Buffalo & Susquehanna system from 1898, about 110 miles in all. I have not the data of cost of the latter work, except that with the low price of labor, the cost per mile, including rental of engines, cars, etc., and the cost of labor, did not exceed $275 per mile. As much as 5,700 ft. of track was laid in a single day with about 65 men, through the winding valleys of the branches of the Susquehanna River, south of Wharton, Pa., and the average kept up to very close to a mile a day, where any considerable grade was ready ahead of the track layers.

On the line between Wellsville and Buffalo there were a large number of bridges to be constructed, as the track laying advanced, the steel for the bridges being brought over the new line, so that the track layers hardly became organized for rapid work before they were stopped for a period of from two or three days to two months, while the new structures were being erected. During this period the track layers were ballasting the new track, or engaged in completing unfinished track on troublesome fills. The laborers, especially the spikers and members of the iron gang, had previous experience, and had in general become quite expert in the work.

About one-third of the men were Hungarians and the balance Italians. No natives were employed. While at first the Slavs were decidedly the better laborers, some of the Italians became expert in spiking and in handling the rail, so that spike gangs and iron gangs were made up of Italians and Hungarians, creating a rivalry which expedited the work considerably. Two truck gangs were always employed, passing each other by using a portable turntable, or by lifting the heavy truck body from the wheels. Good camp cars were provided, and also a well-equipped blacksmith's shop. A combined gasoline engine and pump, and a tank of 10,000 gals. capacity—which could be quickly taken down and erected—formed part of the equipment, so that the locomotive used in the track-laying could be kept close to the work.

The longest stretch of grade which was ready for the track and where no large bridges intervened to delay the work, was between Belvidere and Belfast and White Creek bridge. On this stretch it was demonstrated what a track-laying gang could do when the organization was well in hand. This work does not compare with feats in the west over a level country, but among the winding roads of the east, it does compare very favorably. The biggest day's work on this stretch was 5,000 ft. and the average for the 6 miles was 4,600 ft. per day.

North of White Creek bridge, 5,900 ft. was laid on July 2, 1905, including a delay of several hours placing a small bridge at Transit Bridge. The average for this one gang during the time employed was about 4,400 ft. per day.

Other smaller gangs were employed out of Arcade and Hamburg, working north and south to reach important large structures nearby, and while these did not accomplish as much in a single day, the average of about 50 ft. per man was attained.

The track-laying gang was made up about as follows:

1 foreman, at $4	$ 4.00
2 assistant foremen, at $3	6.00
12 spikers and nippers, at $1.50	18.00
36 trackmen, at $1.50	54.00

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*From the Erie Railroad Employes' Magazine, By H. C. Landon, formerly division engineer of the Erie, now general manager of the Watangua R. R.

2 tie liners, at $1.50	3.00
2 tie spacers, at $1.50	3.00
1 spike puller, at $1.50	1.50
4 bolters, at $1.50	6.00
2 rail unloaders, at $1.50	3.00
4 tie unloaders, at $1.50	6.00
1 water boy, at $1.25	1.25
Total	$105.75
Behind the supply train, full tie-ing:	
1 foreman, at $3	$ 3.00
24 laborers, at $1.50	36.00
1 timekeeper, at $2	2.00
Total	$ 41.00
At storage yard, loading rail and ties:	
1 foreman, at $3	$ 3.00
24 laborers, at $1.50	36.00
Engine and crew, at $40 per day	40.00
Total	$ 79.00
Total in all	$225.75

The average amount of track laid per day was over 4,000 ft. At 4,000 ft. per day the cost per mile would be $297.97. As much material, rail, ties, etc., was received while track laying was in progress, the expense of rehandling in the supply yard was avoided.

The auditor's books, when rail laying was completed between Wellsville and Buffalo, indicated the entire cost of labor for laying 98.1 miles of track to be $29,515.45, or $300.85 per mile. Of this 98.1 miles of track, 85 miles was main track and the balance sidings, "wye" tracks, and passing tracks.

The labor cost included the building of the turnouts, etc. This is the total cost of labor, including engine and train crew, fuel, supplies and rental of engine and of office force. The rail laid was 80-lb. A. S. C. E. section.

CROSSTIES PURCHASED, 1910.*

The demand for material to supply the crossties required in maintaining the present trackage of railroads and in building extensions is one of the heaviest to which the forest resources of the country are subjected, and since a very large waste is involved in the usual method of producing ties, the extent of this demand is but partially indicated by the large annual purchases of crossties. Practically all the material used for crossties comes from the forests or timberlands of the United States, less than 1 per cent of the crossties purchased in 1910 being of imported wood. The number of crossties now in use or held for renewals on all classes of railroads of the United States is probably not less than one billion.

In 1910 the steam and electric railroads together purchased 148,231,000 wooden crossties, or 20 per cent more than in 1909 and 32 per cent more than in 1908. Of the total number purchased in 1910, only 8,635,000 ties, or 6 per cent, were reported by the electric roads. The statistics for 1910, which were secured by correspondence, cover over 99 per cent of the known mileage of all railroads in the United States.

Although by far the greater part of these purchases were for the maintenance of existing track, approximately 22,255,000 ties, or 15 per cent, were for new track. This percentage is the same as that reported in 1907, the year of the greatest total purchases, when 23,557,000 ties were bought for new track. In 1909 only 16,437,000 ties, or 13 per cent of the total number reported, were purchased for this purpose, and in 1908 only 7,431,000, or 7 per cent. Thus the statistics indicate a partial return in 1910 to the economic conditions encouraging track construction which prevailed in 1907.

Of the ties purchased by the electric railroads in 1910, 2,656,000 were for new track, which number is slightly greater than those reported in 1909 and 1908, but only about seven-tenths as great as that in 1907, 3,835,000. In each of these years ties purchased for this purpose formed over 30 per cent of the total number shown for the electric railroads. This high percentage is due partly to the fact that much of the electric road mileage has not been in existence long enough to require the normal proportion of tie renewals, but is mainly accounted for by the fact that these lines are being extended with greater relative rapidity than the steam roads.

Table 1 shows the total number of crossties purchased each year from 1907 to 1910 and their distribution according to the kind of wood, these kinds being arranged in the order of importance in 1910.

The principal qualities desired in a tie wood are durability, spike-holding power, and resistance to mechanical wear. The leading species used for crossties are mainly very durable woods, but the rank of the different kinds of wood thus used does not necessarily indicate their relative desirability for the purpose. The available local supply of timber largely determines the kinds used for ties in different parts of the country.

Many species of oak are first-class tie woods, and as a group they are more widely available than any other kind of suitable timber. As in previous years, oak and southern pine were by far the most important woods, supplying together nearly 64 per cent of all ties purchased in 1910. The number of oak ties reported, over 68,000,000, was the largest ever recorded for any kind of wood, being 20 per cent greater than in 1909. More than 26,000,000 southern pine ties were purchased in 1910, representing an increase of 23 per cent as compared with the preceding year. The proportions of the total formed by each of these kinds of ties were, however, practically the same in the two years.

Among the oak ties are included a number of imported Japanese oak ties. Altogether less than 2,000,000 ties were imported. Ohia lehua, a wood imported from Hawaii, is represented among the ties included under the head "All other." In this group are also included about 134,000 mesquite ties and ties of locust, hickory, cherry, sycamore, hackberry, walnut, and several other species purchased in small quantities, principally by the steam railroads.

Of all crossties used, by far the greater number are hewed from the tree, a practice which involves great waste of timber. It is, however, gratifying to note that the proportion so produced in 1910 was the lowest recorded since annual statistics on the subject have been secured. Hewed ties formed 74 per cent of the total in 1910, as compared with 77 in 1909 and 82 in 1908. This decrease in the percentage of hewed ties is due principally to changes in the proportion of such ties among those made of oak and Douglas fir. Among oak ties the proportionate number of sawed ties has gradually increased since 1908, and the large increases shown since that year in the

TABLE 1.—*Crossties purchased, by kinds of wood: 1907 to 1910.*

KIND OF WOOD.	CROSSTIES PURCHASED (NUMBER).			
	1910	1909	1908	1907
All kinds	148,231,000	123,751,000	112,466,000	153,703,000
Oak	68,382,000	57,132,000	48,110,000	61,757,000
Southern pine	26,264,000	21,385,000	21,530,000	34,215,000
Douglas fir	11,629,000	9,067,000	7,988,000	14,525,000
Chestnut	7,760,000	6,629,000	8,074,000	7,851,000
Cedar	7,305,000	6,777,000	8,172,000	8,954,000
Cypress	5,396,000	4,589,000	3,457,000	6,780,000
Tamarack	5,163,000	3,311,000	4,025,000	4,562,000
Western pine	4,612,000	6,797,000	3,093,000	5,019,000
Hemlock	3,468,000	2,642,000	3,120,000	2,367,000
Redwood	2,165,000	2,088,000	871,000	2,032,000
Gum	1,621,000	378,000	262,000	13,000
All other	4,466,000	2,955,000	3,764,000	5,626,000

*Joint report by the United States Forest Service and the Department of Agriculture.

use of Douglas fir have been mainly in sawed ties, the number of hewed ties of this species having remained about the same each year.

A higher percentage of sawed ties in 1910 than in 1909 was shown also for chestnut, cedar, cypress, western pine, and other less important woods. In most cases the tendency toward an increase in this class of ties is much more strongly brought out by comparison with 1907.

Douglas fir and western pine are the only woods from which a high percentage of sawed ties is at present produced, ties made by this method forming 88 per cent of the total number shown for the former and 49 per cent of that shown for the latter. It is noteworthy that these woods, which are supplying ties with little waste in manufacture, are likely to become of increased importance as future sources of supply for cross-tie material.

The total quantity of ties purchased has not as a whole been much affected by changes in the cost of ties. The average price paid per tie was 51 cents in 1910, which is the same as in 1907 but greater than in 1908 and 1909, when the figures were 50 cents and 49 cents, respectively. While 1908 marked the lowest point in the total number of ties purchased during recent years, the average price shown for all ties did not reach the lowest figure until 1909.

The steam roads purchased 94 per cent of the total number of crossties reported, and the relative proportions of the different kinds of wood among the purchases of these roads were about the same as in the railroad industry as a whole.

The deterioration of timber by preventable decay causes a heavy demand upon the timber resources of the country. In 1910 nearly 126,000,000 crossties were purchased to make renewals. By the adoption of devices to retard wear and methods to prevent decay, however, the present trackage could probably be maintained with approximately one-half the quantity of wood at present consumed annually for this purpose. To employ measures which increase the average length of time ties may remain in service without decay is equivalent to increasing the supply of timber.

In 1910 the number of treated crossties reported was over 30,000,000, which represents a gain of more than 8,000,000, or 39 per cent, over 1909, and a gain of nearly 7,000,000, or 28 per cent, as compared with 1908, when the figure was higher than in any other year prior to 1910. Since, however, the treated ties in 1910 represented but 21 per cent of the total number purchased in that year, it is evident that there is still a considerable opportunity for the further extension of this economy. Both steam and electric roads show great relative gains in the number of treated ties reported.

Personals

J. Adams has been appointed supervisor of maintenance on a new division of the Baltimore, with office at Somerset, Pa.

W. F. Muff, formerly roadmaster on the A., T. & S. F., has been reappointed roadmaster of the Middle division, with offices at Newton, Kan. He succeeds Arthur Jung, who has been transferred to Ellinwood, Kan., succeeding Joseph Waterhous, transferred.

J. C. Holden, assistant engineer of the Canadian Pacific at Winnipeg, has been appointed division engineer with offices at the same city, succeeding F. Lee, promoted. C. H. Fox, resident engineer at Ft. William, succeeds Mr. Holden.

C. I. Knowles, assistant general foreman of water works, Illinois Central, has been appointed general foreman to succeed C. E. Thomas, resigned to accept a position with a construction company. The office is at Chicago.

H. J. Anderson has been appointed roadmaster of the C. & N. W. to succeed J. H. Brown, resigned; office at North Fond du Lac, Wis.

W. O. Galbreath has been appointed engineer maintenance of way of the Missouri & North Arkansas, office at Eureka Springs, Ark.

The office of division roadmaster has been abolished on the Colorado Midland. T. Kennedy, formerly division roadmaster, has been appointed general roadmaster with office at Colorado City. D. Quinn, formerly division roadmaster at Colorado City, has been appointed assistant general roadmaster, office at Colorado City.

J. A. Heamen has been appointed division engineer of the Grand Trunk Pacific, office at Fitzhugh, Alb., succeeding J. Callaghan, appointed division engineer of the Pacific Great Eastern.

M. Clark has been appointed roadmaster of the Gulf, Colorado & Santa Fe, with headquarters at Brownwood, Tex.

Charles Sullivan has been appointed roadmaster at Silsbee, Tex., succeeding R. W. Grooch.

The Southern is asking for bids for the construction of a brick freight warehouse and office building 300 ft. x 50 ft., to be built at Raleigh, N. C., and has let the contract for the construction of a brick freight warehouse and office building 228 ft. x 50 ft. at Goldsboro, to J. P. Pettyjohn & Co., of Lynchburg, Va.

The Great Northern it is reported will build a large freight house at Duluth, Minn.

The Fort Dodge, Des Moines & Southern has prepared plans for the construction of a steel bridge to replace the present high trestle at Boone, Ia. The contract for the work will probably be let in the near future.

The Missouri, Kansas & Texas has awarded the contract for the construction of a steel bridge over the Colorado River, which will cost about $192,000.

The Lake Shore & Michigan Southern has submitted plans to the mayor and the board of public works, of Toledo, O., for the extension of its yard at Air Line Junction, which will cost approximately $2,000,000.

It is reported that the Philadelphia & Reading and the Pennsylvania will construct a concrete bridge over the Schuylkill River to cost about $250,000.

The Norfolk & Western it is said will shortly begin the construction of a large coal pier, a new roundhouse, shops freight houses, and will increase its yard trackage at Lamberts Point, Va.

A contract has been given to Norton, Griffiths & Company, according to reports, for railway terminal improvements to be carried out at Courtenay Bay., N. B., at a cost of about $7,500,000. This work is to be completed within four years and calls for the construction of a breakwater, dredging work in the harbor, reclaiming a site for railway terminals, and constructing about 4,734 ft. of wharves.

The St. Louis & San Francisco it is said is negotiating for 1,600 ft. of wharf space along the river front at New Orleans, La.

The Southern Pacific and the San Pedro, Los Angeles & Salt Lake have plans for a joint passenger station at Los Angeles, Cal. The Atchison, Topeka & Santa Fe will build a station of its own.

At a recent meeting of the City Council, Covington, Ky., the Louisville & Nashville was granted permission to construct a steel girder double-track bridge to replace the present archway under the C, N. & C. traction lines in South Covington.

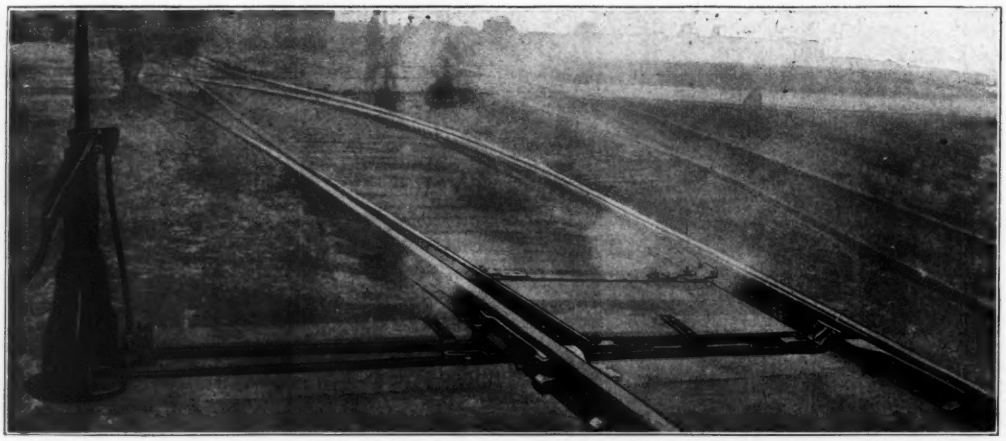
The Philadelphia & Reading has awarded a contract to build a passenger station at Valley Forge to Enos L. Seeds, same city. Specifications call for a structure of stone, 5 feet wide by 63 feet 4 inches long.

Among The Manufacturers

SIMPLE LOCK FOR FACING POINT SWITCHES.

It has been recognized for a long time at interlocking plants that switch points should be locked in proper position, and an indication given to the tower man that points are in absolutely correct condition. This condition has been met by the locks worked from the signal tower.

There are a great many switches in non-interlocking territory which should have a lock which would be reliable. The need for such a lock is especially apparent on facing point switches. Wrecks have been caused by loose fitting points or a switch run through and then lined for main track and left without reporting to the maintenance department. In one case a switch on a yard lead was run through in this manner, and in order to protect himself the trainman did not report it. The next string of cars that came down the lead were derailed and badly smashed up. A positive lock on the points would have prevented this wreck, the disaster of which would have been much worse if it happened on a high speed main line.



McKinnis Switch Point Lock, Showing Attachment to Stand.

The McKinnis lock, illustrated herewith, has been on the market for several years. It is designed to give a positive lock on the switch points, and has been installed and successfully operated on a large number of railways.

As shown in the illustrations, the locking device consists of two shoes, one on each rail. These shoes slide along the rail base, to which they are attached by lugs. The head of the shoe is far enough away from the web of the rail to just barely clear the point when it is closed tightly against the rail. Raising or lowering the switch lever moves the two blocks forward to a position where they lap over the switch rail 3 or 4 inches, or backward to clear the switch point. When the lever is raised the locking blocks move forward to clear the point. The switch is then thrown over, and when the lever is lowered to lock, the block will move forward again. If the closed switch point is the least bit loose, the head of the sliding shoe will hit against the end of the switch rail, the handle can then not be pushed home, and the padlock cannot be put on the switch stand.

In case the switch or connecting rod should break, or a bolt work loose due to the rattle and jar of passing trains, the locking device will still hold the switch absolutely closed and safe for traffic.

The use of this switch lock gives a facing point switch the maximum safety. If a switch is run through and the switch rail is bent, it will be impossible to close and lock the switch. In case the switch rail and lock is not bent or broken, but the rods and stand are damaged, the switch can be used with perfect safety, while making repairs, by throwing the switch rails over with bars and forcing the shoes to place.

Where a switch has three switch rods, it is possible for the No. 1 rod to become broken, and have the switch still operate so as not to call the attention of a trainman to the damage. On the far side, the point under ordinary conditions would not be closed tight when the lever was thrown and locked. A sufficient opening might easily be left in this case to allow a sharp flange to enter it and cause a disastrous wreck. With the switch lock herein described a check is obtained on all such conditons, and when the handle is home and locked, the switch point must be locked unless the block is broken. In case the switch is run through, the blocks are broken and the switch put in such bad order that it cannot help but be detected immediately.

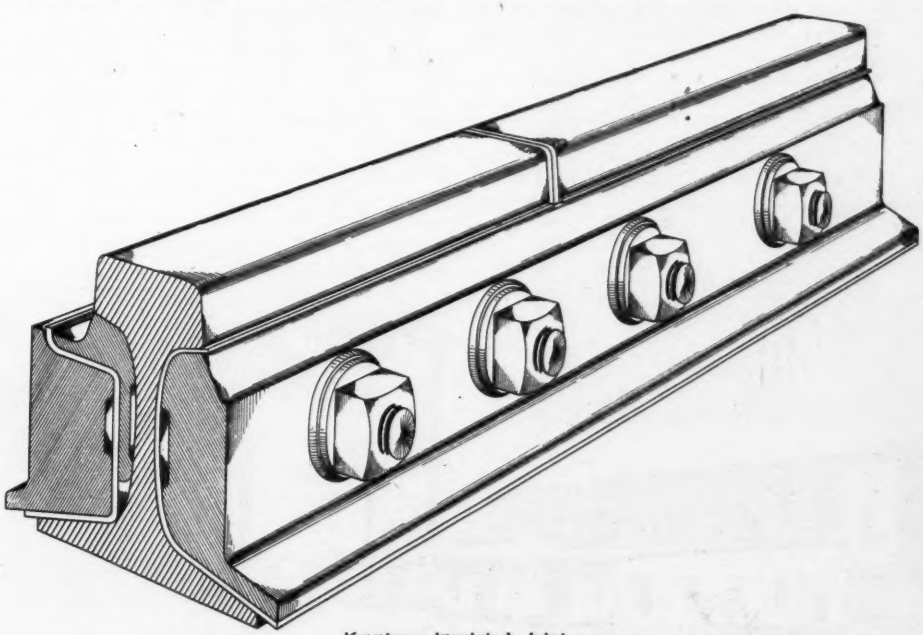
The design is extremely simple, with few parts, and these are durably made of malleable iron and steel. The shoe is made in two parts and bolted together after placing on the rail, making the installation very simple. The lock is attachable to any kind of a switch stand, from which it is operated without extra motion.

The McKinnis switch lock is being marketed by the McKinnis Switch Lock Co., 507 S. Dearborn street, Chicago, from whom further particulars can be had on request.

McKinnis Switch Point Lock.

KEYSTONE INSULATED RAIL JOINT.

Since railway signaling systems employing track circuits have made necessary the use of insulated rail joints, manufacturers of these appliances have endeavored to produce a joint which, besides providing efficiently against current leakage, would possess the mechanical strength of the ordinary angle bar track joint, and be capable of holding the track in proper surface and alignment. In addition to these qualifications the ideal joint should be easy of application, and cheap from the standpoint of maintenance and renewals.



Keystone Insulated Joint.

The Union Switch & Signal Co., manufacturers of the "Keystone" insulated joint herein illustrated, claim for their product all of the qualities to be desired in this most important element of the track circuit.

Excepting the fibre insulation, the large area of which reduces the pressure per square inch to a minimum, no material other than rolled steel enters into the construction of the Keystone joint.

The metal filler under the rail head, in addition to providing a large bearing surface for the fibre, is well adapted to withstand the shock from passing trains, and it is to this feature of construction that the manufacturers point in justification of their claim for the long life of their joint and the low cost of maintenance and fibre renewals even under the most severe traffic conditions.

The angle bar section is such that the "Keystone" joint is stronger to resist both vertical and horizontal stress than is a joint of the non-insulated type, the rigidity of construction permitting of the bolts being firmly fastened and remaining so; this amply provides against the vertical movement of rail ends with relation to each other and results in a reduced risk of rails breaking through the bolt holes (a fault so common in joints of the insulated type), as well as making for long life of the fibre insulation. The variation in space between rail ends at insulated joints, due to rail contraction in cold weather, is overcome by the "Keystone." It retains its proper spacing and permits the non-insulated joints to open uniformly.

The ease with which the "Keystone" joint may be applied appeals strongly to track men. No part of it goes between the base of the rail and the ties; therefore no lowering or adzing of ties is necessary—an important saving of labor where long ties are used because of the presence of many frogs and switches, or where it is desired to install insulated joints on unballasted bridges or similar structures.

This joint, after severe test, has been made standard on a number of large railroads, where it is said to be giving efficient and economical service.

VAUGHAN SPLICE STRAIGHTENER AND RAIL BENDER.

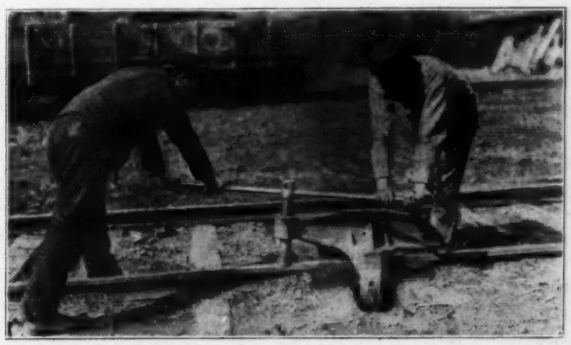
The tool illustrated herewith is a splice straightener and rail bender and serves the double purpose of straightening surface bent splices and of curving or taking alignment kinks out of rail.

The operation of this device is very simple. Used as a splice straightener, it is seated squarely on top of the rail, over the splice to be straightened, with the slots in the legs at the center of the splice. The lifting bars are inserted in leg slots, and the screw is turned up until the rail and splice are straight.

For straightening bent splices not in track, the splice is bolted to two rail ends, forming a complete joint, and the joint is then straightened as described above.

For use as an ordinary rail bender, the device is laid on its side with the legs straddling the rail. The bearing blocks are inserted and the screw turned up as far as desired.

It is well known that joints should not be neglected until the splices and occasionally the rails are bent, but they fre-



Vaughan Splice Straightener and Rail Bender.

quently are. Should the splices become so bent, the joint may be again raised to the proper surface, but such raising also results in lifting the ties and "cocking" the rail at the quarters. It is common practice in such cases to tamp the joint ties hard and leave the quarters slack, trusting that the next train will straighten the splice. This procedure rarely gives satisfactory results. By using the splice straightener the bent splices can be brought back to exact surface.

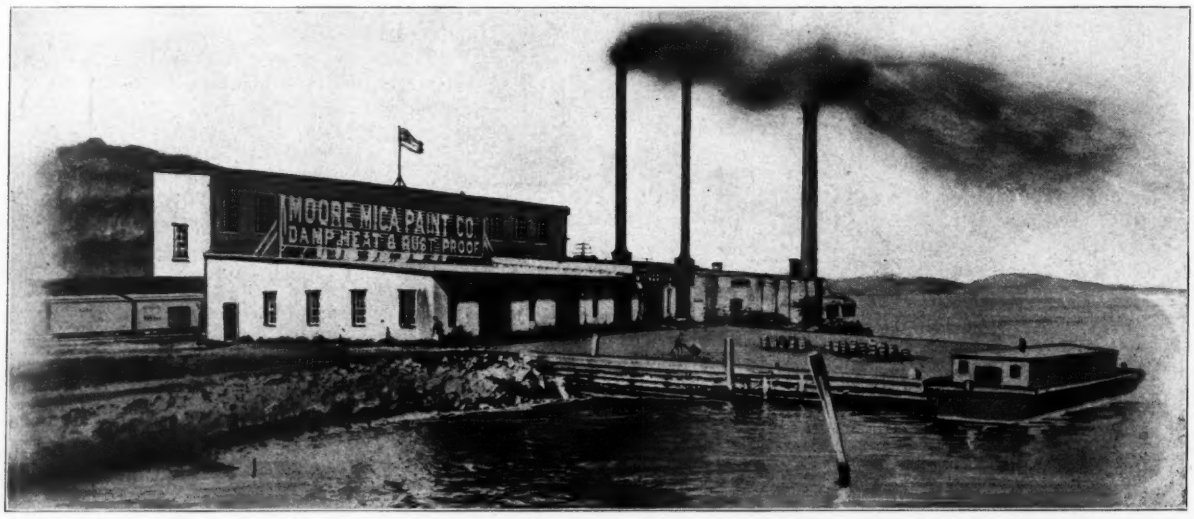
Splices are frequently removed, heated and "straightened" with a sledge. The cost and results of this method are excessive, and many splices that are slightly bent but otherwise fit for service are relegated to the scrap heap.

Used as a rail bender, this device is the most powerful on the market. Two men can easily bend the heaviest "T" rail sections.

The Vaughan rail splice straightener and rail bender is a product of the M. W. Supply Co., Philadelphia, Pa., which company handles the Vaughan combined tie plate and anti-creeper. The latter device has been successfully used for a number of years.

placed over the crevice to be stopped and made as air-tight as possible by a thick, yielding gasket against the cement surface, with the brace and screwjack behind it to resist the pressure. Compressed air is then turned on sufficient to drive back the water, and the mica paint is admitted to the bowl and, backed by the air pressure, is driven in to fill the cracks. When one crack, or a portion of it, has thus been treated the bowl or air tight chamber is placed to cover another crack, and so on until all the leakage has been permanently cured.

This method was successfully employed upon the Hudson River tunnels of the Pennsylvania and elsewhere. The operation as described seems simple enough, but in the practical employment of it of course judgment and experience count for much, and especially does the success of it depend upon the use of a filling material which completely satisfies the imperative requirements. The Mica paint, is said to have been thoroughly tried by the paint experts of the New York Central, Baltimore & Ohio, Pennsylvania and



Plant of Moore Mica Paint Co.

WATERPROOFING AGAINST PRESSURE.

The accompanying sketch shows the operation of a device which is being successfully employed for filling cracks and stopping leaks in concreted tunnels which are subject to external water pressure. Minute cracks or larger unfilled crevices extending entirely through the material occur in concreted subaqueous tunnels, these being either found at once upon the completion of the work or developing later in consequence of natural shrinkage or from the jar and strain of heavy traffic. The resulting inflow of water is a constant source of annoyance and expense, and if not quickly remedied results in delay and stoppage.

On account of the water pressure, leakage of this character can never be stopped by the application of paints or cements upon the exposed surfaces, as they are washed away as soon as applied. The water which is flowing through the cracks must first be driven back and the space it occupies must be filled with the waterproofing material, and this material must have the property of adhering where it is placed and of immediately assuming a permanent hardness, thus making it not only a filling but also a binding or strengthening material. Mica Paint has been employed in connection with the apparatus described herein and has been demonstrated to completely satisfy all these requirements.

As shown in the illustration a large cast iron bowl is

the American Car & Foundry Co. for steel cars. Both the apparatus and the paint are controlled by The Mica Paint Company, 76 William Street, New York.—Compressed Air Magazine.

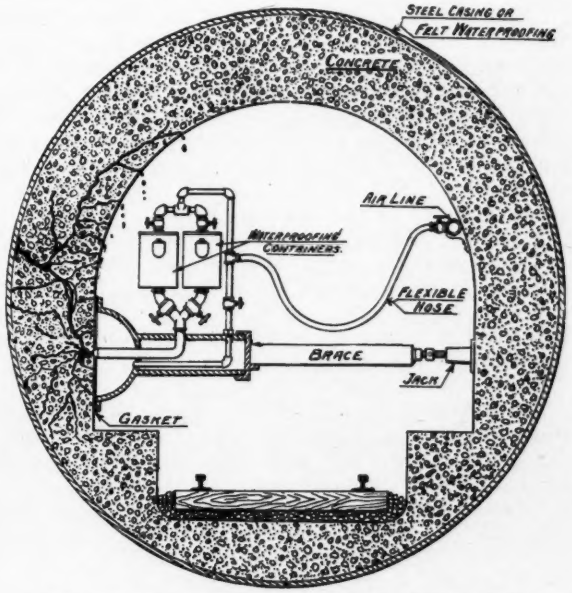
PRIZE WINNERS IN THE VOTING CONTEST ON WEIGHT OF FROG.

The prizes in the voting contest carried on by the Indianapolis Switch & Frog Co., described in the April issue, have been awarded. Mr. Henry Peters, construction foreman of the Chicago and Northwestern took the first prize.

Before the next ten closest guesses were reached, a large number of the guesses were found at 1,200 lbs. In order to treat all alike the number of fountain pens was increased to include all those who made guesses at that figure. Following is a list of those receiving prizes for the 20 closest guesses:

No.		Lbs.	Oz.
747	Henry Peters, const. foreman, C. N. W. R. R., Milwaukee, Wis.....Diamond ring	1200	80
444	G. B. Owen, E. M. W., Erie R. R., Jersey City, N. J. .....Fountain pen	1203	2
140	Wm. Van Gorder, supvr., C. C. C. & St. L. Ry., Middletown, O. .....Fountain pen	1210	0

416	Dode Rex, road master, C. I. & S. R. R., Kankakee, Ill.	Fountain pen	1210	0
477	W. J. Kelleher, pur. agt., N. O. & N. E. R. R. New Orleans, La.	Fountain pen	1210	0
525	H. W. Geoff, rd. mast., A. & W. Ry., Ashland, Ohio.	Fountain pen	1210	0
108	Willis Foraker, Erie R. R., Bippus, Ind....	Fountain pen	1201	8
131	A. Burgett, supvr., Erie R. R., Huntington, Ind.	Fountain pen	1201	2
656	J. M. Cronk, bkm., G. T. R., Pt. Huron, Mich.	Fountain pen	1200	10
115	C. H. Lindsay, D. E., N. Y. C. & H. R. R. R. Co., Albany, N. Y.	Fountain pen	1200	0
143	R. W. Aerloff, towerman, Illinois Central R. R., Riverdale, Ill.	Fountain pen	1200	0
267	John Dolton, supvr., C. & E. R. R., Hammond, Ind.	Fountain pen	1200	0



Moore Process for Repairing a Leaky Tunnel Lining.

296	G. J. Graves, D. E., A. T. & S. F. Ry., Dodge City, Kan.	Fountain pen	1200	0
299	W. E. Emery, C. E., P. & P. A. Ry., Peoria, Ill.	Fountain pen	1200	0
363	Geo. Loy, gen. foreman, L. S. & M. S. Ry.	Fountain pen	1200	0
417	G. C. Adams, R. M. C. C., C. I. & S. Ry., Kankakee, Ill.	Fountain pen	1200	0
467	J. R. Houghland, A. E., C. & A. R. R., Joliet, Ill.	Fountain pen	1200	0
491	C. Gould, foreman sig. dept., C. B. & Q. R. R. Co., Cicero, Ill.	Fountain pen	1200	0
811	A. Hubur, Chicago Rys. Co., Forest Park, Ill.	Fountain pen	1200	0
875	W. H. Sloan, timekeeper, I. C. R. R., Chicago, Ill.	Fountain pen	1200	0

The watch fobs are to be distributed just as soon as the owner's initials can be put on them.

Contracts have been let by the Kettle Valley for grading 25 miles west of Carmi, B. C., as follows: C. H. Williams & Co., six miles; Millighan, Dussault & Co., nine miles, and Porter & Connelly, 10 miles. A. McCulloch, chief engineer, Penticton, B. C.

FOLDING TRACK VELOCIPEDE.

A track velocipede was exhibited at the recent exhibit of railway supplies, which embodies some noteworthy features. The Red Cross folding velocipede illustrated herewith was designed to meet the need for a railway velocipede which would be light and easy running. An additional feature is that the third wheel and arm may be folded in against the side of the frame and and easily loaded into a baggage

Red Cross Track Velocipede.

car, or upon the platform of a passenger car. It is very easily folded up after loosening only one thumb screw, and when folded can be hung up against the wall of an office or tool house, taking up no floor space, or if left standing, it will occupy a floor space only 24x12 ins.

The weight of the car complete is 52 lbs. and it can be easily carried in one hand. It is a one man car, but can be used for two men if desirable; tools also are easily carried.

The car is light, speedy and strong. The low weight and great strength of the car is made possible by the use of a trussed frame of selected white ash, wheels of pressed steel, and all other mechanism made from the highest quality of steel adapted for the various services.

The car is speedy because it is geared up, and is easy running because ball bearings are used throughout. These bearings require oiling only at rare intervals.

The frame work of the velocipede is strong on account of its trussed design and construction from the best materials. All connections are of tough stamped sheet steel. The material is so distributed as to give strength at the points of greatest stress.

The velocipede can be propelled with the feet or hands

Red Cross Velocipede Folded.

or with both. The stroke may be made long or short at will. The power is applied direct, and there is no possibility of moving the lever without moving the drive wheel. The brake can be applied without releasing the hand from the driving lever.

The folding feature makes this velocipede especially useful for track or signal inspections. On windy days, the inspection can be made in either direction by loading the car on a train and riding against the wind, either going or coming, and doing the inspection going or returning, as desired. The car is instantly and easly folded, loaded, and is again easily unfolded and will be in perfect adjustment when the thumb screw is tightened.

The durability and strength of this car make it especially desirable to inspectors and all other railway employes who can advantageously use a car in going to and coming from work, and the cost is said to be very low for a car of this kind.

PERMANENT EXPOSITION OF RAILWAY SUPPLIES.

The interest shown by railway officials in the permanent exposition of railway supplies in the Karpen building, 900 South Michigan Boulevard, Chicago, is very much more than was anticipated. The exhibition can be made headquarters for railway officials when in the city, every convenience is at hand, as well as the facilities of a high class club, without charge; they can have their coats, grips and packages checked, telegrams can be received and sent—to say nothing of the opportunities in the way of an exposition, where modern railway devices can be seen and examined without haste or annoyance—there is little doubt that this exposition will be a national meeting place for railway men in general. It saves the time, expense and annoyance of travel from place to place to see the various kinds of mechanical devices.

The first meeting of a railway association in the building, that of the car foremen of Chicago, was held Monday evening, March 11th. This body was very much pleased with the accommodations and conveniences. On March 19th, the Western Railway Club held its regular monthly meeting at the exhibit. W. J. Walsh of the Galena Oil Company read a paper on lubrication. A working demonstration was made at the time the paper was read. The use of live steam in mechanical devices showed the operations in detail. This was a most interesting meeting. The Car Clerks' Association held its first regular monthly meeting in the assembly room of the Karpen building Monday evening, April 1st.

The formal opening, which was from March 16th to 23rd, inclusive, was an event long to be remembered because of its being the opening of the first permanent exposition of railway supplies in this country. A very interesting program in the way of entertainment was arranged, and an invitation was extended to every railroad man in the United States, Canada and Mexico to visit the exposition whenever they are in Chicago and to make the place their headquarters. Over thirty thousand invitations, with tickets of admission and a booklet describing the exhibition, were mailed. A very large number of responses were received by the management.

A large number of exhibits by some of the well known supply manufacturers are in place and more are being installed every day. Nearly all of the available space has been reserved.

The Erie has given contracts for second-track and grade reduction work between Concord, Pa., and Meadville, 35 miles, to the following contractors: Ferguson & Edmonson Co., Brookville, Pa.; Robert Grace Contracting Co., Cleveland, Ohio, and T. A. Gillespie, New York.

New Literature

The Rabok Manufacturing Co. has issued an attractive catalogue describing "Rabok" paint. This paint is used as a protection on all kinds of steel structures, bridges, ships, locomotives, engines, etc. The catalogue states that the paint is intended for protecting under especially severe conditions, such as brine, smoke and sulphur fumes. The booklet is well illustrated, showing structures on which this plant has been used.

* * *

Catalogue No. 2, issued by the A. N. Doud Engineering Co., describes the Doud grab bucket. The strong points of these buckets are fully described and illustrations are shown of the device in operation. Illustrations and descriptions are also given of special designs of machinery for handling earth, rock, sand, gravel, concrete, etc.

* * *

Catalogue sections "A" and "G" of the General Railway Signal Co. have been sent out. They are made up in loose leaf form with substantial covers, making it easy to insert new pages, or pull out those which are superseded. Section "A" is devoted to mechanical interlocking machines and accessories. "G" relates to electric interlocking machines and accessories. The catalogues are very carefully edited, and are excellently illustrated, so that they form valuable permanent additions to the signalmen's library.

Bulletin 128, General Railway Signal Co., discusses the A. P. block system for single track railroads. This system is described in detail, with sufficient illustrations to fully explain the text. The leaves are bound in but are also perforated, and if desired the leaves can be removed and placed in the standard loose leaf catalogue cover.

* * *

The Concrete Form & Engine Co., Detroit, Mich., has just issued a neat booklet describing "Belle Isle" motors for hand cars, and also "Belle Isle" motor cars complete. The booklet is attractively illustrated and arranged and gives a complete description of the devices. In this catalogue the company aims to treat the subject entirely from the standpoint of the man who buys his own car, offering him a complete car if he wants it; or a separate engine to fit his own car, with accessories and fittings of standard size, so that he can buy a complete equipment and have every part necessary to install.

Industrial Notes

The Chicago Utilities Co., it is reported, has been organized under the laws of Maine for the purpose of controlling the tunnel, telephone, warehouse, terminal, and dock properties involved in the reorganization of the Chicago Subway. The board of directors will be: Henry W. Deforest of Deforest Brothers, New York; William Stuart Tod of J. Kennedy Tod & Co., New York; Samuel McRoberts of the National City Bank, New York; Irving T. Bush of the Bush Terminal Co., New York; R. J. Dunham of Armour & Co., Chicago, and C. W. Hotchkiss, Chicago.

John Lucas & Co. have moved their Railway Sales Department from the Old Colony Bldg., Chicago, Ill., to 945 Peoples Gas Bldg.

The next regular meeting of the New York Railroad Club will be held at the building of the United Engineering Societies, No. 29 W. 39th St., Friday evening, April 19, 1912.

The Hurst Automatic Switch & Signal Co., St. Louis, has purchased a large site on the western side of St. Louis, and

will put up a plant of which the first unit will cost about $250,000.

Young's Rail Joint Co., Oklahoma City, Okla., has been organized to manufacture patented continuous rails and boltless angle bars. The officers of the company are: J. D. Young, president; D. C. Clark, vice-president; R. E. Britain, secretary and L. A. Brittain, treasurer. The offices of the company are located in the Colcord building Oklahoma City, Okla.

The American Railway Supply Co., New York, has moved its general office from 24 Park place, to its new factory building at 134-136 Charles street, same city.

The Browning Steam Shovel Co., of Cleveland, Ohio, has been incorporated with a capital stock of $125,000, and will take over the plant of the Browning Manufacturing Co., manufacturing steam shovels, drag line excavators and dredges at Mansfield, Ohio. The Browning Steam Shovel Co. has opened a Cleveland office at 542 Rockefeller building. George S. McIntosh, 508 Rockefeller building, Cleveland, has been appointed advertising manager of the new company and of the Browning Foundry Co.

Mr. W. E. Buckingham, who has been associated as salesman with the New York office of the Lackawanna Steel Co., has been appointed general manager of sales of the National Bridge Works, with general offices at 1123 Broadway, New York, and shops at Long Island City.

ARMORED BOX CAR.

The rolling stock officials of Mexican railways have found it necessary to fulfil unusual requirements in car service on account of present political difficulties in that republic.

A car fitted up for military use by the Mexican Government is one of the latest innovations. It is made from an ordinary box car, the inside of which is lined with steel armor plate.

Three of the end holes are for two machine guns and one rapid fire gun. There are also eight windows at the top of the sides, which are used for ventilation when the car is not under fire. They are protected by steel shutters, which are slid over them when the car is in the danger zone. Ladders are placed at both side doors, so arranged that they can be readily swung down as soon as the door is opened, or lifted up into the car after it has been loaded. The ceiling is lined with metal, which provides protection from any attack from vantage points above the car. Although this car would not be a protection against shells, it is of decided advantage where only musketry fire is concerned. The outside of the car is painted with the checkered effect to hide the location of the port holes.

RAILWAY CONSTRUCTION.

The following minor improvements for its line in Texas are planned by the Santa Fe. Track changes at Fort Worth, approximate cost $8,500; construction of a creosote oil tank of 1,000,000 gallons' capacity at Galveston, estimated cost $11,300; improvements for machine shops at Clebourne, drilling deep well and machinery to operate same at Sanger, $10,000; construction of a creosoted timber viaduct with a 34-ft. span across tracks at Allen street, Fort Worth, at a cost of $17,700. This company has also authorized the construction of 100 miles of second track on the Coast Lines during the ensuing year. It is understood that 30 miles will be between Seligman and Yampia, and 12 miles between Needles and Topock. The main line of the system between mile post 888 and 909, Valley division, will be reballasted at a cost of $107,000.

According to reports the Canadian Northern will start work soon on the Duluth, Winnipeg & Pacific, over which, when completed, the Canadian Northern will enter Duluth, Minn.

Surveys are now under way for double-tracking the Canadian Pacific main line between Vancouver and Calgary, a distance of over 600 miles. This is one of the most extensive improvements undertaken by the Canadian Pacific since the completion of the main line.

The Chattanooga, Rome & Atlanta Interurban, according to reports, is ready to begin grading work as soon as a charter can be secured in Georgia. A charter has been granted to the company in Tennessee. The projected route is from Chattanooga, Tenn., southeast to Atlanta, about 85 miles. C. Reir is president, Chattanooga.

The Chicago, Burlington & Quincy has let the contract for having the road double tracked from St. Louis to Woodlawn, near Mount Vernon.

The Arkansas Valley Interurban has secured right of way, it is said, for an extension north from Newton, Kan., to Goessel, 44 miles. Charles D. Bell, chief engineer and superintendent, Wichita, Kan.

The Atlantic & Western is to start work at once on an extension. The line is now in operation from Sanford, N. C., to Broadway, 12 miles. The company's charter permits it to build to Goldsboro, N. C., west to the Tennessee river, 300 miles. F. G. Hatton, vice-president, Roanoke, Va.

The Chicago & Illinois Midland is contemplating the construction of an extension from Taylorville, Ill., to Nokomis. It is said that surveys are already under way between Lowder and Auburn, a distance of 8 miles.

The Aurora, Mendota & Western has been incorporated, with office at Plano, Ill., to build from Yorkville, in Kendall county, Ill., west to Mendota, LaSalle county, about 40 miles. The incorporators include G. H. Simpson, Wheaton; C. S. Williams, Yorkville, and C. A. Darnell, Plano, Ill.

The Bartlett Western will build an extension from Bartlett east to Cameron, about 30 miles. An extension is also projected from Florence to a point west.

It is rumored that the Chicago, Milwaukee & Puget Sound is planning to let contracts shortly for the construction of the proposed line from Plummer, Idaho, to Bell, Wash.

The Chicago, Rock Island & Pacific is reported to be planning to reconstruct its tracks from Forrest City, Ark., to Bridge Junction by raising and building a second track practically all the way. An expenditure of $700,000 will be required.

The Crosbyton-South Plains is planning to build an extension to connect with the Stamford & Northwestern at Spur, Tex., about 28 miles. A line is also projected through Guthrie, Okla., and Benjamin, Tex., to Seymour, where a connection is to be made with the Gulf, Texas & Western, and the Wichita Valley lines. A branch to Matador is also contemplated.

The Columbus, Chattahoochee Valley & Gulf has been chartered with a capital stock of $500,000, and proposes the construction of a railroad from Georgetown, Quitman county, to Atlanta, a distance of 180 miles. The incorporators include John D. Little of Atlanta.

The Dunlap Northern & Pacific has been incorporated in Oklahoma, to build from Dunlap, Harper county, Okla., north to a connection with the Union Pacific at Ellis, Kan. The incorporators include H. D. Knight of Oklahoma City.

It is rumored that the Grand Rapids & Indiana is planning to build a northern branch from Muskegon to Manistee, Mich., over the proposed route of the Muskegon-Manistee interurban.

The Great Northern is said to be making surveys for an extension through McKenzie, Dunn, Oliver and Mercer counties, N. D.

The Louisville & Nashville, it is reported, will spend $12,000,000 for improvements in Tennessee and Alabama. Of this amount $5,528,000 is to be spent in Alabama. The improvements include double-tracking work, new bridges, yards, etc. The yards at Montgomery, Ala., are to be enlarged to about three times their present size.

Recent Engineering and Maintenance of Way Patents

ANTI-CREEPER AND SPLICE BAR.

1,023,991—F. B. Byers, New York.

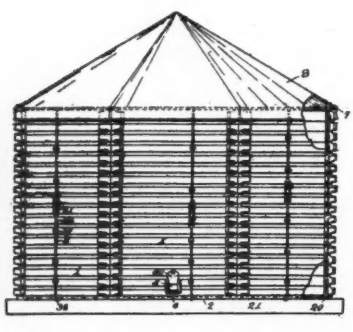
The combination with the meeting ends of rails, of splice bars or holders comprisng webs having central inwardly and downwardly inclined lugs, angularly bent tie engaging portions formed integral at each end of the lugs and upon which the rail bases rest. Each web is provided near its extreme outer ends with angular extensions, the upper edges of both the angular bent portions and extensions resting flush against the under surface of the rail bases, thereby forming tie engaging faces for contact with the confronting sides and outer sides of a pair of ties. Means are provided for clamping the bars or holders to the rails.

CAR RE-RAILER.

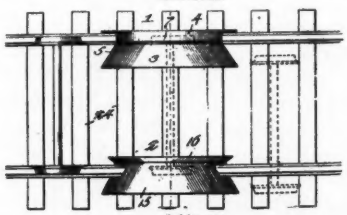
1,024,049—W. H. Allen, Welch, W. Va.

A car replacer having its lower portion cut away longitudinally whereby a means is provided for the reception of the rail and to permit the device to rest steadily upon the ties, and comprising an arched guide head, and a track-engaging web, the guide head being inclined downwardly and toward the track-engaging web, the web having its inner face adjacent the guide head inclined upwardly, and the point of juncture of the guide head and web forming a channel providing a means to prevent the wheels of the car from slipping off the replacer. The guide head is of hollow formation and is provided with a plurality of transversely arranged reinforcing members so as to effectively support the wheels of the

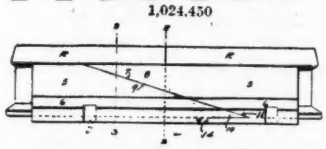
1,024,133



1,024,049



1,024,450



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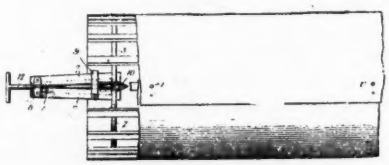
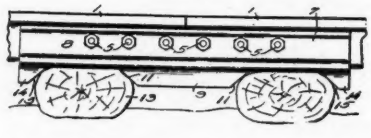


1,023,991



car to be positioned thereon, and the lower extending portions of the device are of equal length and provided with integral formed teeth, and further provided with alining eyes adapted for the reception of a removable bolt, the bolt being adapted for the reception of the nuts whereby a means is provided to securely and quickly fasten the device upon the track and ties.

CONCRETE CULVERT CORE.

1,023,429—J. W. Kempf, Goehner, Neb.

A form for use in making culverts, the same comprising, in combination with the web of a culvert, timbers pivotally connected at one of their ends and at their opposite ends carrying semi-circular disks or members, a wedge interposed between and longitudinally movable within grooves formed in the meeting faces of the timbers. A key or rod is provided for regulating the movement of the wedge to expand the semi-circular members outward.

SCREW SPIKE.

1,024,127—C. J. Gadd, Lebanon, Pa.

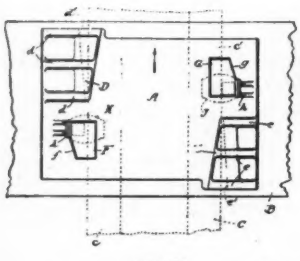
A screw-spike the under side of the head of which is spherical, and a washer having a spherical seat for the head and a hole for the shank of spike, a tapered underside to engage the top of the flange of a rail, the front of the washer having a convex bottom adapted to rest upon a tie or tie-plate, the washer having shoulders to engage the side of the rail flange.

KNOCK-DOWN BIN OR TANK.

1,024,133—M. V. Hostetter, King County, Wash.

A knock-down bin having walls composed of tongue and grooved

1,024,114



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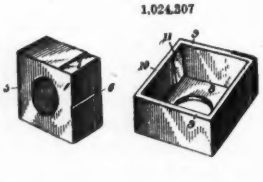

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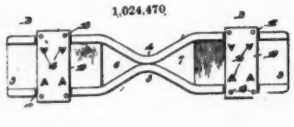
1,024,470



the tongued edge half way across the board and at the other end having a notch extending from the grooved edge half way across the board, the grooved edge of the board having an auxiliary transverse groove extending opposite to and parallel with the walls of the notch in the tongued edge and adapted to receive the tongue of a board in the adjacent tier, the ends of the boards beyond their transverse notches having a bolt extending transversely therethrough from edge to edge, and a clip embracing the edge of the board and placed as a washer upon the bolt at its notched side.

COMBINED RAIL ANCHOR AND TIE PLATE.

1,024,114—B. B. Betts, St. Louis, assignor to Positive Rail Anchor Co., Louisville, Ky.

A combined tie-plate and rail anchor provided with diagonally opposite gripping jaws, the device having spike openings at its opposite ends, one at least of the spike openings being of a size greater in the direction of the length of the rail than the diameter of the spike for which the opening is intended and so as to permit the device to turn about the spike within the other spike opening in order to increase the gripping action of the jaws.

NUT LOCK.

1,024,307—Robert Boles, Eldersville, Pa.

In a nut locking device, the combination with a bolt, of a washer, integral walls carried thereby, a wedge carried by the inner side of one of the walls, a slit nut arranged in the washer and having boards each having at one end, a transverse notch extending from a beveled face engaged by the wedge of the washer, the nut and the washer being screwed upon the bolt whereby the washer will clamp the nut upon the bolt.

RAIL JOINT.

1,024,450—Stephen James, Youngstown, O.

A boltless rail-joint comprising, in combination with the rails, a pair of duplicate joint-members, each of which consists of a rail-chair having opposite side angle-bar portions, one of which is provided with an inclined bearing seat and a projecting beveled tenon at the lower end; the other side angle-bar portion is cut away at its under side at an oblique angle to form an extended wedge-shaped joint-tongue overlying the seat of the other joint-member, and with a wedge-shaped mortise that receives the tenon of the other joint-member.

METALLIC TIE AND FASTENER.

1,024,470—A. C. Candland, Provo City, Utah.

A railway tie comprising U-shaped end members and arcuate plates connecting the end members, the upper edges of the end members being provided with horizontally disposed flanges, rail seats comprising side walls and top, the top being extended without the side walls, and means to secure the rail seats to the flanges.

The Bethlehem Steel Co. has an order for 8,000 tons of rails for shipment to South Africa.

The Canadian Pacific, it is said, has ordered 15,000 tons of open hearth rails.

The Central of Georgia is reported to have ordered 3,800 tons of rails.

The Grand Trunk Pacific, it is said, has ordered 40,000 tons of Bessemer rails.

An ordinance has been introduced into the City Council of Philadelphia, Pa., authorizing the construction of new bridges over the Philadelphia, Baltimore & Washington at 65th street and 72nd street. The ordinance also provides that the railroad pay $40,000, one-half the expense.

The Pennsylvania is constructing a new Jersey City station at Summit avenue. Upon its completion it will be the main station of the road in that city. It has not been determined to what use the old Jersey City terminal of the company will be put.

New Dixon Railroad Booklet

We have just prepared a booklet treating of the various Dixon graphite products for use on the railroad. The entire Dixon railroad line is treated of and all other matters excluded—this booklet is of interest only to the various mechanical railroad departments.

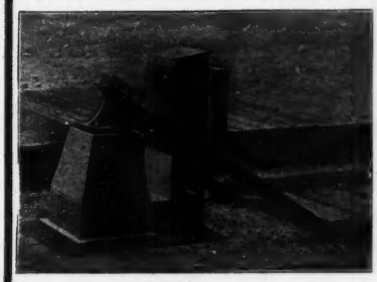
The application of dry graphite for lubrication, the use of Dixon's graphite greases, Dixon's Silica-Graphite Paint, crucibles, facings, crayons, etc., is all included in this booklet—a total of 40 pages. There is bound to be some matter to interest you here.

We have tried to make our booklet attractive in appearance as well as interesting to read, and to this end have included views taken of railroad stations and yards, stretches of track, signals, bridges, etc.

Write for copy of this booklet by number 187 R. R.

Joseph Dixon Crucible Co.

Jersey City, N. J.



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Noted for Simplicity, Strength and Lasting Qualities. Adapted to all positions.

Mechanical Mfg. Co.,
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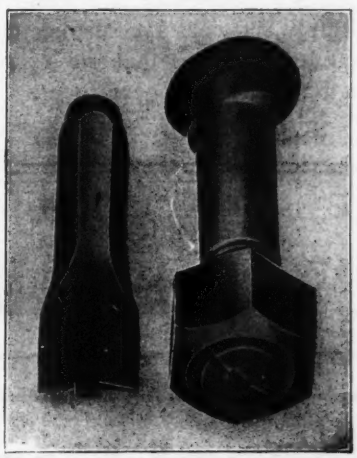
THE CLARK NUT LOCK



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By D. H. LOVELL
Division Superintendent Pennsylvania Ry.

An Instructor and Guide for Roadmasters, Section Foremen and Construction Foremen

This book is presented in a very clear manner, which is at once simple, thorough and practical.

The contents include chapters on General Turn-outs; Stub and Split Switches; Analysis of Curves; and a large number of tables for the quick and correct construction of any switch.

Cloth, 174 pages; 4½x6¼ inches.
Price, $1.00, net postpaid.

Maintenance of Way Standards, by F. A. Smith, M. E., C. E. - Price, $1.50
Standard Turn Outs on American Railroads, by F. A. Smith - Price, 1.00
Railway Curves, by F. A. Smith - - - - - - - - - Price, 1.00

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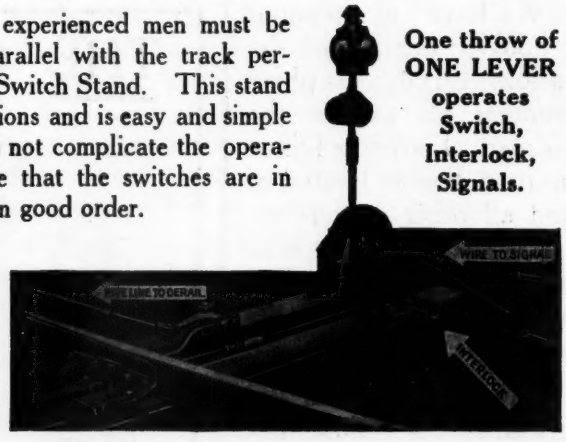
FOSTER

Interlocking Switch Stand

You make a careful inspection of switches to see that they hold the points up to the rail. The Foster Interlocking Switch Stand guarantees the points to be up to the rail and secured with two separate connections from the points to the ties. The lever will not enter the latch until the point is up to the rail and bolt locked. If there is lost motion in the connections or an obstruction between the point and the rail the lever cannot be forced down into the latch. With this stand the points must be kept adjusted within safe limits to be able to operate the stand.

Any track device which is not operated by experienced men must be simple and positive. One throw of one lever parallel with the track performs all operations with the Foster Interlocking Switch Stand. This stand guarantees safe switches between times of inspections and is easy and simple to operate. It provides additional safety and does not complicate the operation of your switches. Your inspection is to see that the switches are in good order and this stand is made to keep them in good order.



One throw of ONE LEVER operates Switch, Interlock, Signals.

Foster Interlocking Switch Stands have been tested in service and do all that is claimed for them.

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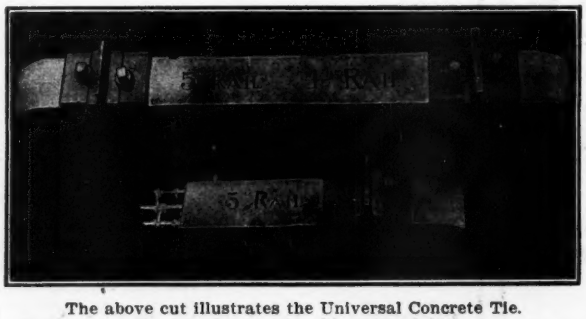
The Universal Concrete Tie

Note carefully the details of the spiking device and the peculiar "V" shape of the base of the Tie at the center, which insures an absolutely perfect alignment, obviates spreading of the rails, or the slewing of the track. The heavy hardwood cushions preserve the rolling stock as well as the tie; last for six to fifteen years, and are then almost instantly removed by the loosening of the screw spikes by one man.

The Percival Patents

In use under various Trunk Line Railways for five and six years past.



For further facts and full evidence, address the

UNIVERSAL CONCRETE TIE COMPANY

1408-9 Whitney-Central Bldg. NEW ORLEANS, LA.

The above cut illustrates the Universal Concrete Tie.

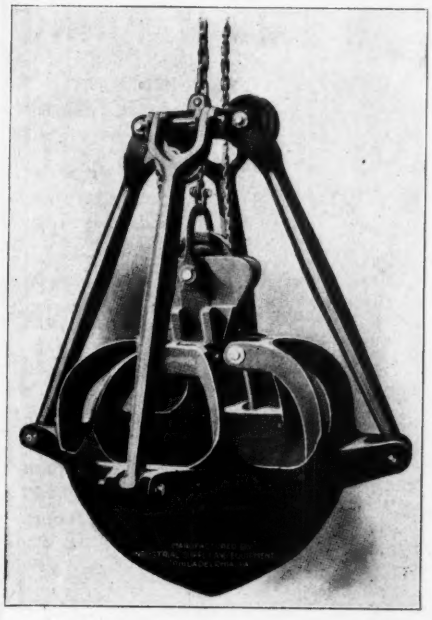
Trains are running sixty miles an hour over these ties, and have been so running for more than five years, yet they have had no repairs, realigning or even tightening of the spiking devices.

The reinforcement of our ties consists of four corrugated bars, the approximate length of the tie, and varying in size from 1-2 in. to 1 in. These are secured in proper shape by electro-welding the heavy binding wires. The truss core of the tie thus forming a complete unit within itself.

The best tie for terminals, because it is permanent.

The best tie for yards, because it is fire proof, rust proof, and will hold rails true to gauge.

The best tie for main lines and heavy traffic, because it is absolutely dependable under all conditions, as we can show in roads using them.



Rickards Cast Steel Orange Peel Buckets

The Bucket for Hard Service

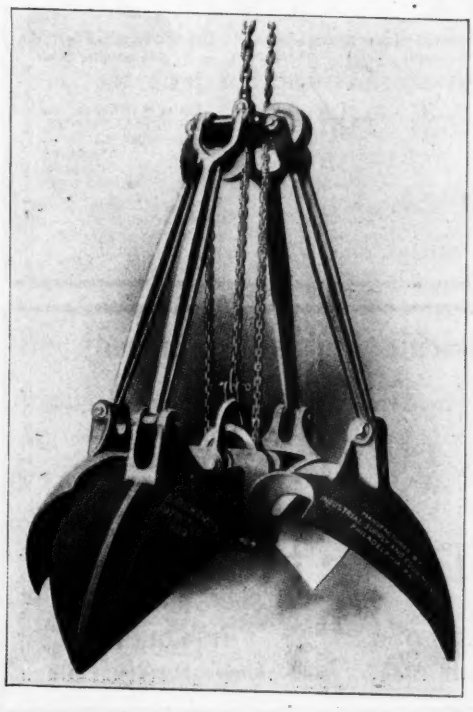
Rickards Orange Peel Buckets are constructed with four curved triangular cast steel blades, and when closed form a tight semi-spherical bowl, which holds the excavated material.

Rickards Bucket parts are interchangeable and are numbered and lettered. Reference to the number of the bucket being all that is necessary in ordering any part.

The Center Block is made of cast steel and fitted to carry and allow the bucket to hang central at all times.

All buckets are fitted with chain wheels, as this construction has been found more desirable. Buckets to be operated by wire rope will be furnished if so ordered.

The Rickards Orange Peel has been so designed that three sizes of blades can be used on the same crown rigging. That is, you can buy say a 1 yard Bucket and also buy ¾ yard and 1¼ yard blades for same rigging.



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407 Sansom Street, Philadelphia

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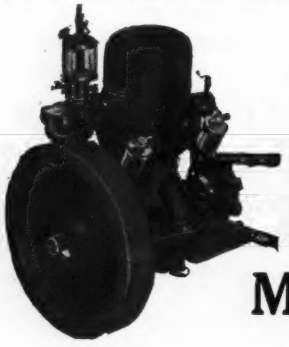
Change

—from 1 m. p. (man power) to 2½ h. p.

—from 3 miles an hour and hard labor to 30 miles and no work at all.

—your hard-pulling, back-breaking, slow-running velocipede, into a speedy and reliable little motor car.

2 to 2½ H. P.



3 to 30 Miles

You can make the change yourself in a short time. The engine is sent you all ready to be installed. It is complete with extended axle and roller bearing.

"The Belle Isle Engine gets you there and back"

Write Today for Catalogue No. 40

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FAIR WARNING

—Given By—

OUR NUMBER 333

Locomotive Crossing

BELL

Gives a very loud and distinct warning

IT IS AN ENGINE BELL

The gravity operated circuit closer absolutely insures its operation.

Wound to operate on from 2 to 600 volts.

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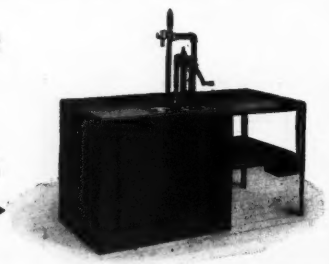
Chicago **New York**

Bowser Table Tank for Way Stations



It just fits the conditions at way stations or oil houses for cleaning and filling signal lamps.

The pump measures the oil into the lamp and the table catches any dirt or spilled oil. The table serves also as an ideal place for trimming and cleaning the lamps.

This is but one unit of the

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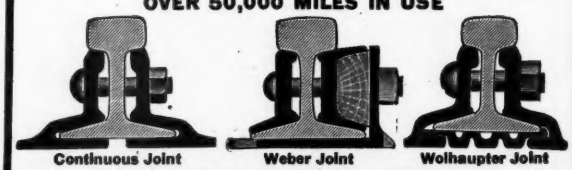
OVER 50,000 MILES IN USE



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Makers of Base-Supported Rail Joints for Standard and Special Rail Sections, also Girder, Step or Compromise, Frog or Switch, and Insulating Rail Joints, protected by Patents.

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A Guarantee With Every Bucket

DOUD'S PATENT GRAB BUCKET
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The Doud Grab Bucket

Will dig harder material than any other clam-shell bucket made!

WHY?

Because it is reaved different than any other bucket made, and it is reaved right.

Here is what one contractor says:

"We consider its digging qualities *SUPERIOR* to any of the other makes of clam-shell buckets that we have, which include three other well known types."

Here is what another railroad contractor says:

"The 1-yd. Clam-Shell purchased of you is giving entire satisfaction. My superintendent reports that they brought up and landed a rock containing over 1 cu. yd., this being gripped by the teeth."

Not a Sheave or Line on This Bucket Touches the Material Being Handled

Write For Catalogue

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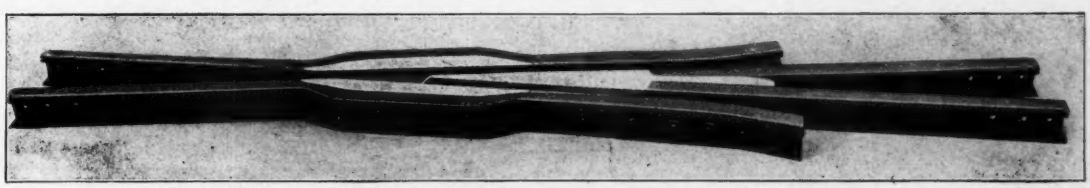
Our products are the result of 30 years' experience in the field.



Manganese Hard Center Frog

Wing rail pieces, throat, point and heel blocks are one manganese casting. The entire wearing surface of this frog is so completely protected with manganese steel that it is especially adapted for use under the most severe traffic. The manganese insert extends beyond the ends of the wing rails in the throat of the frog.

We have one of the largest and most modern plants in the country, and are prepared to give your orders ***prompt attention.***

The Frog, Switch and Manufacturing Co.

CARLISLE, PA.

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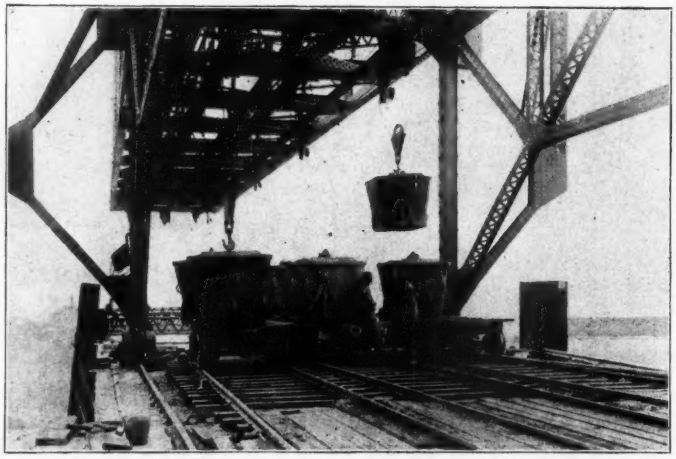
That was the way they ordered the 75

DOUD ACME CENTER DUMP BUCKETS

used on this job

These Buckets were ordered after a thorough competitive trial with the other leading makes of Buckets on the market



What stronger evidence of superior quality could be asked for?

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Doud's "Acme" Center Dump Bucket Gates Open

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To figure out the economies that may be obtained by the use of "Rockford" Railway Motor Cars

The substitution of Magneto for dry cells, spark coil and timer, the welded steel channel frame, the Rockford control and the Rockford engine are advantages that may be measured by the **Standards** of **Common Sense.**

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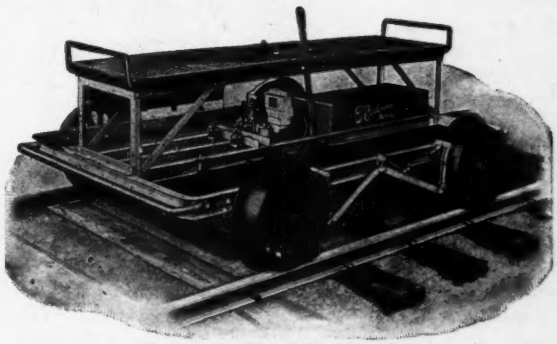

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Simple *Efficient* *Economical*

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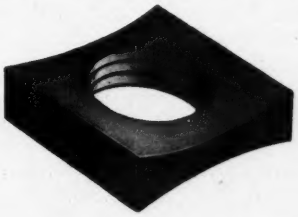
BOSS  NUT

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are equipped with the Kalamazoo Improved Reinforced Pressed Steel Wheel, giving 50 to 100 per cent greater wear than any other wheel of similar design or weight on the market. The car has stout gallows frame, thoroughly trussed, has taper wheel and pinion fits on axles, machine cut gears, flexible steady box and double acting brake.

16 Different Styles, Standard or Special

Catalogue of Track and Railway Supplies on Request

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Kalamazoo, Mich.

Western Representative: W. K. KENLY COMPANY, Chicago

COFFMAN'S PERMANENT WAY

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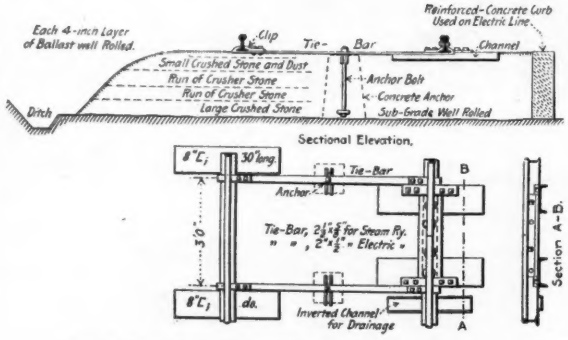
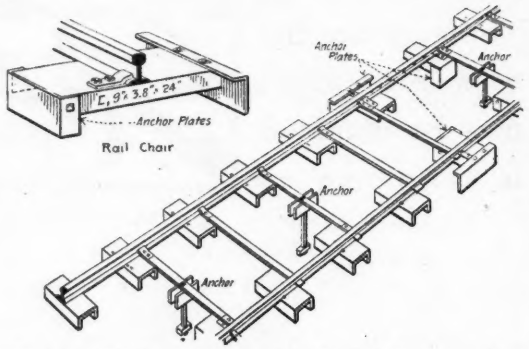


Track Construction with a watertight bed of rolled stone ballast.



Track Construction for very heavy traffic, used in connection with heavily rolled bed of broken stone.

A reinforced compacted monolithic bed or permanent way is a support for the rails and rail chairs. The chairs may be considered under the head of tie plates. My bed represents both the ballast and wooden ties combined. A bed constructed on my plan will answer every condition required of both, and more too. The alignment is permanently maintained, as well as surface and gage. It will admit of the use of anti-creeper appliances. There is a scrapping value in the steel after being used. The bed will not settle out of sight in the soft ground and be lost. It is practically water-tight, and has a tendency to prevent the settlement of embankments. It can be constructed to carry wheel loads of 30,000 lbs. each at maximum speeds.

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900 MICHIGAN BOULEVARD
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W. H. COFFMAN, Inventor
BLUEFIELD, W. VA.

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The Johnson Car Replacer

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Type C for rail up to 65 lbs.	4½ Inches high	30 Ton Locomotive	2½ Ins.	60
Type B for rail up to 80 lbs.	5 Inches high	50 Ton Locomotive	3¼ Ins.	110
Type A for rail up to 100 lbs.	5½ Inches high	80 Ton Locomotive	3½ Ins.	145
Type Z for rail up to 100 lbs.	6 Inches high	100 Ton Locomotive	3½ Ins.	165

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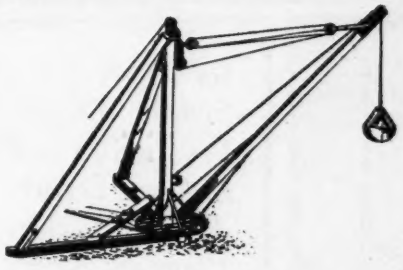
We Guarantee Our Product

Trade Mark—Copyright Applied For.

Pendleton & Co. - Front & Thompson Sts. Stapleton, (S. I.) N. Y.

Hoisting Machinery



We can furnish machinery which will absolutely fulfill your requirements, at minimum cost. :: :: ::

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Hind Hoisting Machinery Co.
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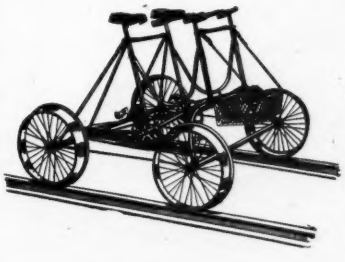

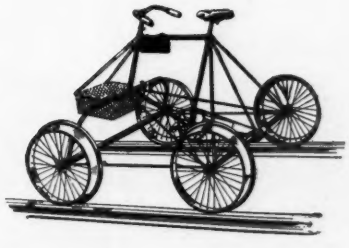

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A New Book full of up-to-date information for every member of the Maintenance of Way department. It should be in the hands of every trackman who is looking for advancement.

PROFUSELY ILLUSTRATED

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By a demonstration of over twenty months under both Passenger and heavy Freight traffic

VAUGHN RAIL SUPPORTS

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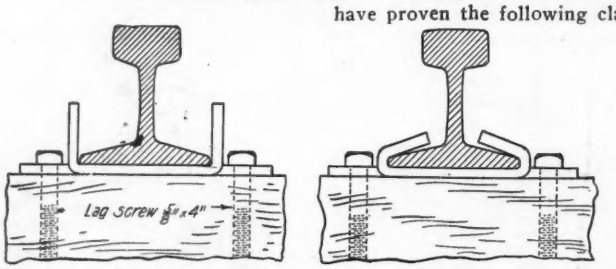
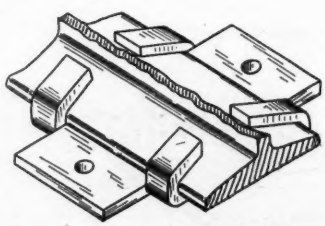
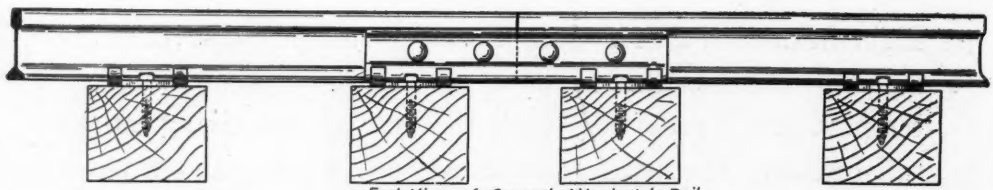


Side View Support Ready for Application

Side View Support Applied



View of Support Attached to Rail.



End View of Support Attached to Rail

No creeping, spreading or kinks. Supports do not loosen on tie or rail.
No deflection or mechanical injury to the tie.
No expense in maintenance since supports were applied.
Eliminates the purchasing of tie plates, because it is the best tie plate on the market, without its other merits.
Also eliminates rail braces, continuous joints, and anti-creepers.
It holds the rail absolutely in alignment either on Tangents or Curves.
It keeps your track to the exact gauge without the use of braces or other devices.
Preserves ties.
Permits the use of the less expensive class of timber.
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It avoids all possibilities of derailments due to rail breakage.
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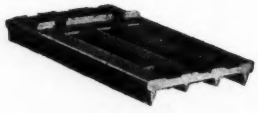
TIE PLATES AND SPIKES

GOLDIE PLATE

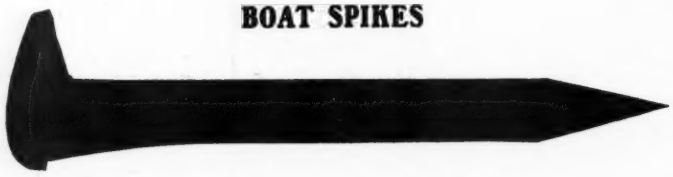


DILWORTH FLANGE PLATE

HARRIMA

Standard and Special Railroad Spikes

BOAT SPIKES



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Nothing but American "Stag" Brand of manganese (the most dependable and serviceable metal of its kind yet produced) is used in our manganese work and in combination with scientific designing and liberal sections with a maximum safety factor—

Nothing is better (no exceptions).

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Workmanship and Methods are confined to the best modern practices only.

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We have every modern and improved facility for the most economical production of strictly High Class Product.

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Indianapolis built up designs of Regular Construction are reinforced and self-contained, prolong the life of the work.

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It is made at

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